Appendix I
Phase 1 Central Treatment Plant Upgrades, Project Design Definition Report, Bunker Hill Mining and Metallurgical Complex Superfund Site (August 28, 2013)

Project Design Definition Report

Phase 1 Central Treatment Plant Upgrades
Bunker Hill Mining and Metallurgical Complex Superfund Site

Prepared for

U.S. Environmental Protection Agency, Region 10

Seattle, WA

August 28, 2013

CH2MHILL®

1100 112th Avenue NE, Suite 500
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Project Design Definition Report

Phase 1 Central Treatment Plant Upgrades

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Acronyms and Abbreviations

°C	degrees Celsius
AACE	Association for the Advancement of Cost Engineering
AASHTO	American Association of State Highway and Transportation Officials
AC	alternating current
AFBMA	Anti-Friction Bearings Manufacturers’ Association
AFD	adjustable frequency drive
AMD	acid mine drainage
ANSI	American National Standards Association
ASTM	American Society for Testing and Materials
AWG	American wire gauge
BWS	backwash supply
CC	collision cell
CIA	Central Impoundment Area
CISD	chemical industry severe-duty
COCs	contaminants of concern
CTP	Bunker Hill Central Treatment Plant
DBW	dirty backwash
DMR	discharge monitoring report
DP	distributed peripheral
EPA	U.S. Environmental Protection Agency
F	flow measurement
FF	filter feed
floc	flocculation
ft	feet
ft^2	square feet
$ft^2/(ton/d)$	square feet per ton per day
gal	gallon
g/L	grams per liter
g/mL	grams per milliliter
gpm	gallons per minute
gpm/ft^2	gallons per minute per square foot

HCl	hydrochloric acid
HDPE	high-density polyethylene
HDS	high-density sludge
HMI	human machine interface
hp	horsepower
HRT	hydraulic retention time
HVAC	heating, ventilation, and air conditioning
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
I/O	input/output
ISA	Instrument Society of America
IT	information technology
KT	Kellogg Tunnel
kVA	kilovolt-ampere
kW	kilowatt
LAN	local area network
lb/Kgal	pounds per thousand gallons
lb/min	pounds per minute
LD	lime demand
LDS	low-density sludge
M	motor
max	maximum
MCC	motor control center
MCP	motor circuit protector
MG	million gallons
µg/L	microgram per liter
mg/L	milligrams per liter
min	minute
mL/min	milliliters per minute
Mn	manganese

mS/cm	milliSiemens per centimeter
Na_2S	sodium sulfide
NAD	North American Datum
NaHS	sodium hydrosulfide
NAVD	North American Vertical Datum
NBHMC	New Bunker Hill Mining Corporation
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PC	personal computer
PCS	plant cont rol system
PFD	process flow diagram
PLC	programmable logic controller
PTM	principal threat materials
PVC	polyvinyl chloride
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
ROW	right of way
scfm	standard cubic feet per minute
SDR	standard dimension ratio
Se	selenium
Se^o	elemental selenium
Se[IV]	selenite
Se[VI]	selenate
sf	square feet
SF	solids formed

SFCDR	South Fork Coeur d'Alene River
Site	Bunker Hill Superfund Site
SRR	solids recycle ratio
TBD	to be determined
TDS	total dissolved solids
TEFC	totally enclosed, fan cooled
Tl	thallium
TM	technical memorandum
TSS	total suspended solids
TU	thickener underflow
TU_c	toxic units, chronic
UL	Underwriters Laboratory
USACE	U.S. Army Corps of Engineers
V	volt
VFD	variable frequency drive
WET	Whole Effluent Toxicity
wt%	weight percent
wt/wt	weight ratio
yd^3/MG	cubic yards per million gallons
Zn	zinc

ES. Executive Summary

Phase 1 CTP Upgrades – Project Design Definition

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DATE: August 28, 2013

ES.1 Introduction

The 2001 Mine Water Record of Decision (ROD) Amendment (EPA, 2001) and the 2012 Upper Basin ROD Amendment (EPA, 2012) include remedial actions for collection and treatment of select metals-contaminated source waters within Operable Unit (OU) 2 and the Upper Basin portion of OU 3 of the Bunker Hill Superfund Site. OU 2 comprises the non-populated areas of the Bunker Hill "Box," a rectangular 21-square-mile area surrounding the former smelter complex. The 300-square mile Upper Basin of OU 3 includes areas of mining-related contamination along the South Fork of the Coeur d'Alene River (SFCDR) and its downstream tributaries to the confluence of the South and North Forks of the Coeur d'Alene River, exclusive of the Bunker Hill Box, Figure ES-1. All figures are referenced in this executive summary (ES) are located in the Figures section at the end of this ES.

The Mine Water ROD Amendment added remedial actions to the Selected Remedy for OU 2 (EPA, 1992) to address the management of acid mine drainage (AMD) from the Bunker Hill Mine. The Mine Water ROD Amendment was necessary in part because the Central Treatment Plant (CTP) which had not been significantly upgraded since it was built in 1974, was not capable of consistently meeting current water quality standards, and the existing sludge disposal area was approaching capacity. Also, the OU 2 Selected Remedy included source control actions to reduce the amount of surface water flow into, and AMD flowing out of the mine. The 2000 CTP Master Plan (CH2M HILL, 2000b) provided technical guidance on the phased implementation of the actions included in the Mine Water ROD Amendment. The CTP Master Plan was updated in 2012 (CH2M HILL, 2012b, currently in draft form) to summarize CTP upgrade approaches in consideration of the additional waters to be treated, as identified in the 2012 Upper Basin ROD Amendment.

The 2012 Upper Basin ROD Amendment (EPA, 2012) clarifies and modifies some of the OU 2 and OU 3 water collection and treatment actions that had previously been selected in prior RODs for OU 2 and OU 3 (EPA, 1992; EPA, 2002). Overall, the water collection actions focus on intercepting metals, contaminated groundwater, and adit discharges emanating from abandoned mining-impacted sites prior to the flows entering into surface water creek and river systems. As described in the 2012 Upper Basin ROD Amendment, some adit discharges, primarily those in relatively remote locations, were designated for onsite passive or semi-passive treatment. The collected groundwater and adit seeps not treated onsite were designated for active treatment at the CTP. The current treatment capacity of the CTP is insufficient to accommodate those additional OU 2 and OU 3 flows designated for active treatment; therefore, actions to increase the capacity of the CTP are part of the Upper Basin ROD Amendment. In addition to increasing the capacity, CTP upgrades are required to improve treatment effectiveness so that potential future effluent water quality discharge requirements can be achieved. As described in the Upper Basin ROD Amendment, it is expected that upgrade and expansion of the CTP will occur in two phases.

The scope of the current project (Phase 1 of the CTP upgrades) is to design facilities to improve treatment performance and accommodate water from a new Central Impoundment Area (CIA) Groundwater Collection System located in OU 2, in addition to the Bunker Hill Mine water that is currently treated. These waters are acidic and contain metals and elements that have been identified as contaminants of concern (COCs) for the Site, including aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, selenium, silver, thallium, and zinc. In the future during Phase 2, the CTP may be expanded to accommodate contaminated waters collected in the Upper Basin (OU 3) and conveyed to the CTP for treatment. The current project scope does not include Phase 2 expansion, but necessary provisions will be included in the Phase 1 design to facilitate future construction, where appropriate.

This executive summary provides an overview of the information included in the five technical memoranda (TMs). The Executive Summary and five TMs combine to serve as the Project Design Definition Report (PDDR) for the Phase 1 CTP Upgrades.

The project design definition phase of the project focuses on four main technical areas as delineated in the scope of work:

- Process Mechanical Design Basis – TM 1
- Civil Site Development Design Basis – TM 2
- Electrical Loads and Design Criteria – TM 3
- Instrumentation and Control Concepts – TM 4

A discussion of the project implementation approach and the estimated cost of the project, at this phase of design, is included in TM 5. TM5 combines the cost estimates for both the CTP upgrades and the CIA Groundwater Collection System. The next project phase, Schematic Design, will build on the concepts presented in this PDDR, and will include TMs covering all technical discipline areas, including geotechnical, architectural, structural, and building services. Final design will follow with an anticipated construction bid date of December 2014, as estimated by the U.S. Army Corps of Engineers (USACE).

ES.2 Process Mechanical Design Basis

The CTP Master Plan (CH2M HILL, 2000b) identified four main processing objectives for the upgraded CTP. These were recently re-confirmed and supplemented by USEPA with two additional objectives (CH2M HILL, 2012b). The objectives for the Bunker Hill CTP upgrade and expansion are:

1. Produce acceptable effluent quality
2. Minimize sludge production
3. Maximize system reliability

4. Incur acceptable capital and operating costs
5. Optimize operation by the commercial sector
6. Maximize sustainability

The overall Bunker Hill mine water collection and treatment system consists of the Kellogg Tunnel (KT) portal system, the mine water pipelines, the Lined Mine Water Storage Pond (Lined Pond), the Sweeney Area pipeline, the CTP, and the unlined Sludge Disposal Cell on the CIA (Figure ES-2). AMD flows from the KT portal into a concrete channel and passes through a Parshall flume where the flow is measured. Maintenance of the concrete portal discharge channel is the responsibility of the Bunker Hill mine owner. AMD then enters a buried high-density polyethylene pipeline (Mine Water Pipelines - Main Line), which conveys it either directly to the CTP (via the Direct Feed Branch) or to the Lined Pond (via the Lined Pond Branch), depending on the pipeline valve settings.

The Bunker Hill CTP is a lime treatment system configured for the high density sludge (HDS) process, Figure ES-3 depicts the current CTP system. At the CTP, the rapid mix tank is analogous to Reactor A in the HDS process and the aeration basin is equivalent to Reactor B. Currently, the CTP oes not have post-HDS filtration. Sand filters were installed in 1979 as part of the original CTP system, but they were removed from service and dismantled by the previous CTP operators because of ineffective treatment and high operating cost. The specific issues with the original filters are no longer known, but they were of an unusual design for this type of application (horizontal pressure filters) and were likely undersized. However, there are other existing HDS plants, as well as conventional lime treatment plants, operating at other locations with filters that provide efficient and effective removal of total suspended solids (TSS) from treated mine water. Furthermore, pilot testing of granular media filtration, at the Bunker Hill CTP, demonstrated good performance (CH2M HILL, 2000b).

Although originally designed and built as an HDS plant, the CTP is not operated to produce dense sludge. This is intentional because it was found that when operating in HDS mode without filters carryover of TSS and particulate metals in the thickener effluent prevented the CTP from consistently achieving compliance with current discharge limits for total recoverable metals. This is because, in HDS mode, the solids recycle is substantially increased resulting in appreciably higher solids loading to the thickener, as well as, somewhat shorter thickener hydraulic retention time (HRT). Consequently, the CTP is currently operated in low-density sludge (LDS) mode with insufficient sludge recycling and sludge inventory in the thickener to produce a high degree of sludge densification. This results in lower effluent TSS and particulate metals concentrations allowing compliance with current discharge requirements.

The CTP also has an unused flocculation (Floc) basin between the aeration basin and thickener, and a large Polishing Pond after the thickener. Treated effluent is discharged from the Polishing Pond to Bunker Creek, and waste sludge is pumped to the unlined sludge disposal cell on top of the CIA for dewatering and disposal.

The Upper Basin ROD Amendment (EPA, 2012) identifies remedial actions that will collect additional flows from source areas in OU 2 and OU 3. These actions are expected to be implemented in phases. The first phase, which is the subject of the current design project, will upgrade and expand the CTP to accommodate the current CTP influent plus the additional flow of OU 2 water from the CIA groundwater collection system. Table ES-1 presents the presumptive design flows for the Phase 1 improvements. The selected design flows span a range from base flow to maximum flow conditions, representing flows encountered in late-summer through winter and during spring runoff, respectively.

Future phases would add additional waters to the CTP influent from OU 3 flows that are collected and conveyed to the CTP for treatment. Potential OU 3 waters for future collection and treatment at the CTP are listed elsewhere (CH2M HILL, 2012a, 2012b).

TABLE ES-1
Presumptive Design Influent Flows

Source	Units	Base Flow Conditions	Max Flow Conditions
Bunker Hill Mine Water	gpm	1,300[a]	5,000[a]
OU 2 Groundwater from CIA Collection System	gpm	2,000[b]	3,000[b]
Total	**gpm**	**3,300**	**8,000**

gpm = gallons per minute

[a]1,300 gpm is the approximate average mine water base flow to the CTP. 5,000 gpm is the current nominal maximum design flow for the CTP; any flow above that must be diverted to either the Lined Pond or the mine pool for temporary storage.

[b]2,000 gpm is the average value predicted by mathematical modeling of the system (assuming both base flow and 90th percentile flow in the SFCDR); 3,000 gpm is based on modeling sensitivity analysis and a safety factor for design.

Table ES-2 presents assumed design influent characteristics for base and maximum flow/strength conditions, based on pilot study data and maximum monthly values calculated from the 1998-99 data, respectively. The characteristics of the maximum flow conditions assumed for design do not represent the absolute worst case mine water quality that is expected to occur. However, it is expected that occurrences of worse water quality discharge from the mine will be infrequent and short-lived, as supported by past experience.

TABLE ES-2
Design Influent Characteristics

Parameter	Units	Base Flow/Strength Conditions[a]	Max Flow/Strength Conditions[b]
pH	std units	3.67	2.65
Conductivity	mS/cm	1.42	2.83
Alkalinity	mg/L as $CaCO_3$	1.5 U	1.5 U
Hardness	mg/L as $CaCO_3$	670	730
Sulfate	mg/L	720	1,700
TDS	mg/L	1,180	2,700

TABLE ES-2
Design Influent Characteristics

Parameter	Units	Base Flow/Strength Conditions[a]	Max Flow/Strength Conditions[b]
Dissolved Metals			
Aluminum	µg/L	820	10,300
Arsenic	µg/L	8.3	810
Cadmium	µg/L	70	490
Calcium	µg/L	144,000	138,000
Copper	µg/L	38	870
Iron	µg/L	5,700	231,000
Lead	µg/L	160	240
Magnesium	µg/L	70,500	107,000
Manganese	µg/L	33,200	77,500
Mercury	µg/L	0.0008	0.58
Selenium	µg/L	2.5	13
Silver	µg/L	1.8	14
Thallium	µg/L	0.72	30
Zinc	µg/L	36,600	177,000

mg/L = milligrams per liter
µg/L = micrograms per liter
mS/cm = milliSiemens per centimeter
TDS = total dissolved solids

[a]Overall average during the 2012-13 pilot study

[b] MaxMonth (maximum monthly average) values calculated from 1998-99 data for use in the pilot study (calculation procedure is described in the pilot study report [CH2M HILL .2013]).

[c]There is some uncertainty about the accuracy of elevated selenium concentrations in old data sets.

ES.2.1 Discharge Limits

Currently, the CTP operates under discharge limitations established by an National Pollutant Discharge Elimination System (NPDES) permit that was issued in 1986 and expired in 1991. Expected future discharge limits were evaluated for USEPA in 2002 and the evaluation was revised in 2007 (CH2M HILL, 2002, 2007b). Table ES-3 presents the current effluent discharge limits for the CTP and the expected future limits. The new limits for metals/elements are considerably lower than the current CTP effluent limits and they include several previously unregulated metals and elements (aluminum, arsenic, iron, manganese, selenium, silver, and thallium). Preliminary discussions by USEPA with their water quality group in the Region 10 Office of Water and Watersheds indicate that discharge of manganese will likely not be regulated to limits as low as those shown in the table because the underlying basis for those values may not be appropriate[1]. In addition, Whole Effluent Toxicity (WET) trigger values, based on acute and chronic bioassay testing using the water flea (*Ceriodaphnia dubia*) and fathead minnow (*Pimephales promelas*), will likely be included in a new discharge permit, in accordance with 40 CFR 122.44(d)(1)(iv) which states "When the permitting authority determines…that a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the numeric criterion for whole effluent toxicity, the permit must contain effluent limits for whole effluent toxicity."

TABLE ES-3
Current and Expected Future CTP Effluent Limits (not considering any mixing zone)

		Current Limits[a]		Expected Future Limits[b]	
Parameter	Units	Daily Maximum	Daily Average	Daily Maximum	Monthly Average
Arsenic	µg/L	--	--	101	50
Cadmium	µg/L	100	50	5.6	2.8
Copper	µg/L	300	150	63.5	31.7
Lead	µg/L	600	300	171	85.2
Mercury	µg/L	2	1	0.020	0.010
Selenium	µg/L	--	--	8.2	4.1
Silver	µg/L	--	--	43.9	21.9
Thallium	µg/L	--	--	0.94	0.47
Zinc	µg/L	1,480	730	489	244
Aluminum	µg/L	--	--	143	71.2
Iron	µg/L	--	--	1,643	819
Manganese	µg/L	--	--	164[c]	81.9[c]
pH	std units	6.0–10.0		6.5–9.0	
TSS	mg/L	30	20	30	20
Dissolved Oxygen	mg/L	--	--	>6	
Temperature	°C	--	--	≤22	≤19
Whole Effluent Toxicity	TU_c	--	--	≤1.0	

[1] The current National Recommended Water Quality Criteria table (online version) does not include a manganese value for protection of aquatic life, but cites 50 and 100 µg/L for protection of human health for consumption of water+organism and organism only, respectively. However, the 50 µg/L value is based on aesthetic considerations (laundry staining, objectionable taste) rather than toxic effects, while the 100 µg/L value is based on the 1976 "Red Book" value for protection of consumers of marine mollusks, which do not occur in the Coeur d'Alene River Basin. Consequently, the applicability of these limits is uncertain.

TABLE ES-3
Current and Expected Future CTP Effluent Limits (not considering any mixing zone)

		Current Limits[a]		Expected Future Limits[b]	
Parameter	Units	Daily Maximum	Daily Average	Daily Maximum	Monthly Average

°C = degrees Celsius
TSS = total suspended solids
TU_c = toxic units, chronic

[a] Metals limits are as total metal. Daily monitoring of copper and mercury is not required.

[b] All metals are expressed in terms of total recoverable metal except for mercury, which is in terms of total metal.
[c] As noted in the text above, future limits for manganese are uncertain, but are expected to be higher than the values shown.

Source: Current limits – CH2M HILL, 2002 (from National Pollutant Discharge Elimination System Permit No. ID 000007-8, expired October 1991); expected future limits – CH2M HILL, 2007.

Three factors that could potentially affect the implementation of the expected future discharge limits are:

1. variances/waivers for specific chemical parameters or use of alternate WET test species;
2. a mixing zone; and
3. a compliance schedule/interim limits, as described further in TM 1.

ES.2.2 Process Mechanical Design Elements of the Upgrade

Table ES-4 provides an overview of upgrades to the CTP that would be necessary in Phase 1 (scope of the current design) and Phase 2, to accommodate selected OU 2 and OU 3 waters, respectively. The existing thickener and the relatively new automated lime system are adequately sized to accommodate the expected Phase 1 flows under most conditions, although temporary storage of some water may be required under short-term, worst-case conditions during periods of exceptionally high mine water flow (e.g. if mine water flow exceeded 5,000 gpm, or if the total influent flow exceeded 8,000 gpm). Most of the other CTP components would be replaced with new equipment.

A preliminary process flow diagram (PFD) for the upgraded and expanded CTP is included in the Preliminary Drawings section at the end of TM 1.

ES.3 Civil Site Development Design Basis

The Project Site is 6.3 acres, located on the south side of Interstate Highway 90, in the city of Kellogg, Idaho. See Drawing C-1 for on overall site plan.

The site development plan requires demolition or relocation of existing site facilities to support construction of the proposed site features.

Facilities to be demolished:

- Rapid mix tank
- Aeration basin
- Flocculation tank
- Polishing pond
- Maintenance Building (relocation)
- Sludge recycle piping

TABLE ES-4
Overview of CTP Upgrades Required to Treat Additional OU 2 and OU 3 Waters

CTP Component	Upgrade Not Necessary	Phase 1 Upgrade (OU 2 waters)	Phase 2 Upgrade (OU 3 waters)	Comments
Sludge Conditioning Reactor (Reactor A)		X	X	One new Reactor A installed in Phase 1 (sized for the Phase 1 design flow). A second new Reactor A installed in Phase 2 (sized for the incremental Phase 2 flow).
Oxidation/Neutralization Reactor (Reactor B)		X	X	A new Reactor B, configured as two vessels in series, installed in Phase 1 (sized for the Phase 2 design flow). A second pair of B Reactor vessels installed in Phase 2 (sized for the incremental Phase 2 flow).
Polymer System		X		A new automated polymer makeup, storage, and feed system installed in Phase 1. Ideally, this would be able to accommodate Phase 2 flows.
Thickener Tank	X			The existing thickener tank is adequate for the expected Phase 1 and 2 flows, under most conditions.
Thickener Rake	X			The existing thickener rake and drives are adequate for the expected Phase 1 and 2 flows. A rake lift is preferred, but not required.
Thickener Discharge Launder, Drop Box, and Feedwell		X		The existing thickener effluent launder and drop box, and perhaps the feedwell, upsized during Phase 1 to accommodate expected Phase 1 flows. Ideally, these improvements would also accommodate Phase 2 flows.
Filtration System		X	X	A new granular media filter system, with capacity installed as needed for Phase 1 and 2 flows. Includes a new Filter/Effluent building, water sumps (filter feed, clearwell, dirty backwash), pumps, and filter vessels.
Effluent Discharge System		X	X	A new effluent discharge system designed to discharge CTP effluent directly to the SFCDR (replacing the existing outfall to Bunker Creek). Installed in Phase 1, but would include provisions for accommodating upgrades in Phase 2. Includes pH adjustment system, effluent monitoring station, pumps, pipeline, and outfall.
Control Building	X			The existing control building is adequate for use with Phase 1 and 2 upgrades.
Lime System	X			The existing lime system is adequate for the expected Phase 1 and 2 flows, under most conditions.
Sludge Recycle and Wasting Pumps		X	X	New sludge recycle and wasting pumps installed as needed for Phase 1 and 2.
Sulfide Addition System		X		A new system for storing sulfide chemical (e.g., NaHS), making up sulfide solution, and metering sulfide solution for enhanced treatment of thallium and possibly other metals.
Effluent pH Adjustment System		X	X	A new system for storing and adding acid to treated effluent to lower pH to within discharge limits, if needed, for Phase 1 and 2 (assuming two separate effluent pipelines).
Piping		X	X	New piping associated with upgrades installed as needed for Phase 1 and 2.

TABLE ES-4
Overview of CTP Upgrades Required to Treat Additional OU 2 and OU 3 Waters

CTP Component	Upgrade Not Necessary	Phase 1 Upgrade (OU 2 waters)	Phase 2 Upgrade (OU 3 waters)	Comments
Electrical		X	X	New electrical associated with upgrades installed as needed for Phase 1 and 2 (see Electrical Loads and Design Criteria, TM 3), including a new motor control center (MCC) and new standby power generator.
Instrumentation & Controls		X	X	New I&C associated with upgrades installed as needed for Phase 1 and 2 (see Instrumentation & Control Concepts, TM 4).
Equipment decommissioning and demolition		X	(X)	Decommissioning and demolition of the existing Rapid Mix Tank, Aeration Basin, Floc Basin, Polymer System, polishing pond, Effluent Monitoring Shed, piping, and pumps.

[a] The need for, and timing for implementation of, a filtration system will be determined during the design process, and design will provide provisions for inclusion/deletion as necessary

- Lime slurry feed piping

The proposed facilities will be constructed on the west portion of site as shown on Drawing C-2. Reactor A and two Reactor B facilities are located adjacent to the west side of the existing thickener and aligned with the access bridge. The Blower/Polymer/Sulfide Building is located between the reactors and the existing thickener, aligned with the existing Pump House and Control Building. The Filter Building is located over the east end of the existing Polishing Pond, and access is on the north side of the building. Access to new facilities will have concrete stoops and aprons for egress, as appropriate.

The Site will be graded so storm water runoff will sheet flow to existing onsite ditches where it will be conveyed to Bunker Creek. The access roads will be designed to have longitudinal grades that will convey the runoff to the existing site drainage features. In locations where the runoff cannot be conveyed through longitudinal grades, catch basins and storm pipe will be constructed to convey the runoff to the preferred location. The site will be analyzed for storm water runoff regarding quality and rate of discharge. Storm water quality and quantity for the improvements will be designed in accordance with the City of Kellogg City Code Title 13: Flood Control.

Standard design practice is to provide finish elevation grades set 0.5-inch below doors to provide accessible entry through each of the facility access points. Grades will slope to approximately 0.5-feet below facility finish floor elevations away from the doors to prevent storm water from entering through the doors.

New buried pipelines will be routed in common corridors, where feasible. It is expected that the CIA groundwater influent force main and CTP effluent pipeline will share a common alignment, where feasible, from the CTP to the outfall as shown on Drawing C-2.

It is anticipated that the CTP outfall will be constructed to discharge at the same location as the CIA surface water drainage outfall located at the northeast corner of the CIA. The existing CIA surface water drainage consists of a riprap lined ditch that outlets into the South Fork Coeur D'Alene River. However, this assumption may change based on whether a mixing zone outfall option is pursued for the effluent discharge. Should USEPA decide to apply for a mixing zone and it is granted by regulatory authorities, then the outfall design would likely include installation of a submerged pipe and potentially diffusers. This issue and the associated tradeoffs will be evaluated early in Schematic Design by USEPA and the CH2M HILL design team.

ES.4 Electrical Loads and Design Criteria

Review of historical drawings shows that the Bunker Hill CTP site is currently fed from a 500 kilovolt-ampere (kVA) AVISTA transformer adjacent to the Control Building. In addition, it shows that a 750 kilowatt (kW) generator was added by the USACE to provide standby power backup for the entire site, sometime in 2005.

Due to the anticipated amount of additional load that will be added to the CTP as part of this project (according to preliminary electrical calculations), the existing 750kW generator and existing electrical service will not be large enough to serve the entire facility at the completion of construction. In order to maximize cost efficiency, and utilize the full capacity of the existing generator, a second standby generator will be added in lieu of redesigning the existing system to accommodate the entire plant.

For a preliminary load summary table showing estimated loads at the completion of construction, see Attachment 3-A. The table has been organized to show the additional loads at each proposed generator and electrical service.

The preliminary load estimate suggests that the new blower/chemical facility can be added to the existing electrical service and standby generator system and remain under the 750kW rating of the existing generator. The existing automatic transfer switch was sized to accommodate a 750kW generator and up to a 750kVA transformer. The transformer size, transfer switch size, and corresponding service size were verified during a site investigation on July 31, 2013.

The preliminary load estimates suggest that the new Filter Building will require a new 750kW generator. The generator size will be refined during design as mechanical loads are further developed.

As mentioned above, the proposed configuration will result in two separate generators to serve the entire plant. This configuration will provide standby generator backup power for the entire demand load of the plant at the completion of construction. Further analysis will be performed during design to explore the possibility of running the plant at reduced capacity to reduce the size of the standby generator and increase cost savings.

ES.5 Instrumentation and Control Concepts

The existing control system includes Siemens “S7” programmable logic controllers (PLCs) and Rockwell Automation RSView 32 human machine interface (HMI) software. Currently, the plant has two PLC controllers. Controller A is a Siemens S7 400, that controls and monitors the aeration basin, clarifier, sludge recirculation and waste pumps, and other peripheral equipment separate from the lime system. Controller B is a Siemens S7 300, supplied by the lime system package vendor, that controls lime slurry makeup and injection, and other equipment located in the lime silos. Controller B has two remote drops, one in each silo, to pick up input/output (I/O) signals. Controller B communicates to the remote I/O in the silos over a Profibus distributed peripheral (DP) serial network.

An Ethernet local area network (LAN) links Controller A and Controller B to each other and to the Rockwell HMI, which is located in the upstairs control room of the Plant Control Building. The HMI consists of two workstations and a server. The server runs one copy of the Rockwell RSView 32 HMI software, the plant data collection “historian”, and the Operations and Maintenance (O&M) manual. Workstation A runs a separately licensed copy of the Rockwell RSView 32 software. Workstation B is an “Active Display Client” to the server, and as such, is a viewing and control workstation for the software running on the server. The existing server and workstations are recommended for replacement with new equipment, current standard operating systems (Windows 7 Professional and Microsoft Server 2008), and current HMI software package, as part of this project.

Processors, in both existing PLCs, are past the manufacturer’s end of life cycle and are not compatible with current versions of the Siemens S7 programming software packages. Several other hardware components in the control system, including the communications modules, are also past their end of life cycle and are no longer supported by the manufacturer. The existing control processors for Controller A and Controller B cannot be addressed, programmed, or modified with current Siemens S7 v12 programming software, and conversely, the new processors and control components expected to be added to the CTP will require the use of current software versions. Therefore, both existing processors are expected to be replaced under this project.

The current control system uses Symatic PC Anywhere software for remote connection by operators. The manufacturer of this software has identified it as vulnerable to hacking and has recommended its removal from critical system applications. Newer technologies, using virtual private networks and firewalls, are available to provide secure access to the plant control system by select individuals.

Existing approaches for plant operations will be used as the basis for control and monitoring of additions to the plant. Plant operators will generally be provided with two separate methods of performing plant operations: manually, and through the plant control system (PCS). Local, manual operation will be provided, where feasible, through the use of local Hand/Off/Auto control of motors and valves, either at the motor control center (MCC), or at local control stations.

Under normal operating conditions, the plant will be run utilizing the PCS. Manual, local control is provided as a backup to PCS control and to provide a level of redundancy. Manual control is useful for troubleshooting and testing purposes, but not all of the built-in software interlocking protections inherent to computer control of equipment will function when equipment is operated in Local/Manual mode. Hardwired, safety interlocks will be used to protect personnel, to allow safe manual control of equipment, for emergency stops, and to protect equipment, where necessary.

Many of the existing PLC components, workstations, and servers at the plant will require replacement. This will require close coordination between plant operations, software developers, and the general contractor responsible for work at the site to allow the continual running of the plant while new hardware is installed.

The existing Ethernet communications will be used and expanded though out the plant to link PLC control components, and for communications between the PLC's and the HMI operator workstations. Most of the communications network within the plant will be adequately served by new network switches and copper Ethernet cabling. A fiber optic LAN will be designed for control communications to the CIA groundwater collection well field sites.

ES.6 Project Implementation and Estimated Construction Cost

Construction of improvements within existing tankage and facilities will require careful planning so that permit limits and operational goals can be met during construction. Constructing the proposed facilities in the midst of ongoing plant operation will require a number of sequencing and construction constraints that will be incorporated into the construction schedule and bid documents.

Key among the constraints is that the existing A and B Reactors occupy the proposed location for the new A and B Reactors. Therefore, temporary treatment facilities will need to be provided by the Contractor, at the location shown on Drawing C-2, or elsewhere as determined by the Contractor and approved by the Government in order for existing A and B Reactors to be demolished and new reactors constructed.

The design of the CTP upgrades is expected to be completed in late-July 2014 according to the project schedule, shown on Figure ES-4. A construction duration of approximately 18 months is expected, resulting in substantial completion of the project in June 2016. The estimated cost of construction for the combined Phase 1 CTP upgrades described in this PDDR and the CIA Groundwater Collection System is about $38 million, which includes 18 months of temporary treatment. TM 5 provides details of this cost estimate which is defined as an order-of-magnitude-level (Class 4) cost estimate, as defined by the Association for the Advancement of Cost Engineering (AACE) with an estimated accuracy range of about +40 percent to -25 percent.

ES.7 Summary and Path Forward into Schematic Design

As described in this Executive Summary, six objectives have been established for the CTP upgrades and expansion. A brief discussion of how these objectives are met with the planned upgrades is described below.

1. **Produce acceptable effluent quality**. Pilot testing demonstrated that effective treatment of most metals (those that precipitate as oxides/hydroxides) is fairly straightforward to achieve via the lime treatment process employed at the CTP, by using the proper treatment pH. However, there are potential issues associated with effective treatment of certain constituents/parameters to achieve compliance with expected future discharge limits. These challenging parameters include total zinc, thallium, selenium, whole effluent toxicity, and pH. Potential corrective measures are discussed in TM 1 for these potential issues. It is expected that these issues will be addressed during the Schematic Design phase.

2. **Minimize sludge production**. The principal avenue for minimizing sludge volume production is operating the CTP in HDS mode, rather than LDS mode. This would reduce the dewatered sludge volume produced by treating Phase 1 water by roughly three-fold. However, this is an operational decision not a design issue. The upgrade design will allow operation in either LDS or HDS mode.

   A secondary means of reducing sludge production is to avoid operating at a particularly high treatment pH. A treatment pH of 10.7 causes substantial precipitation of magnesium as $Mg(OH)_2$, resulting in an appreciable increase in solids mass produced, as well as reduced sludge density. This high treatment pH is used for treatment of thallium and possibly manganese. Consequently, any mitigative measure that reduces or eliminates the need for treatment of thallium would also help reduce sludge production.

3. **Maximize system reliability**. Filters, if/when constructed, would enhance treatment performance reliability by providing removal of total suspended solids/particulate metals that overflow from the thickener. Other than filters, the main way of improving reliability is by providing redundancy, backup systems, spares, and monitors/alarms for key processes and equipment. Preliminary equipment redundancy is indicated in the

equipment lists in Attachment 1-A of TM 1. Further evaluation and selection of redundant and backup systems will conducted in subsequent design phases.

4. **Incur acceptable capital and operating costs**. Operating the CTP in HDS mode would reduce overall water treatment costs by reducing the size/frequency and cost of constructing new sludge disposal facilities. As it was in 1974, the use of lime precipitation remains one the most cost-effective approaches for active treatment of acidic and metals-containing mining-influenced water. In general, the pilot testing and design has and will continue to focus on cost-effective treatment methods, including specialized processes for thallium and selenium and cost-reducing mitigative measures.

5. **Optimize operation by the commercial sector**. The CTP upgrade will be designed to support operation of the CTP by providers in the commercial sector. Areas that will be addressed to facilitate operation by the commercial sector include the use of state-of-the-practice equipment, standardization of instrumentation and controls, accurate as-built drawings and labeling, updated O&M procedures, documented software, and computer interfaces to instrumentation.

6. **Maximize sustainability**. The CTP upgrade will be designed for long-term sustainability to the extent practical. Consideration of green materials and sustainable practices will begin in the next design phase.

ES.7.1 Schematic Design Considerations

Through the PDDR process, several issues have been identified that require additional evaluation, analysis, data gathering, and/or decisions by USEPA during the upcoming Schematic Design phase. Some key issues that will need to be addressed during Schematic Design, along with reference to the technical discipline, are summarized below. Some technical disciplines (like geotechnical) did not have a TM during the PDDR phase but will include discipline-specific discussions in the Schematic Design Report.

ES.7.1.1 Site Civil

- Effluent discharge pipeline: determine optimal alignment, confirm sizing approach (i.e., include consideration now for future OU3 flows?), will discharge permit requirements include a diffuser on the outfall if a mixing zone is granted?

- Influent infrastructure to the CTP: confirm sizing approach (size header pipes, junctions and inlet piping) to accommodate OU 3 flows or align for future parallel system.

- Old Mine Water line to Lined Pond: Rehab or construct new?

ES.7.1.2 Electrical Engineering

- Continue to refine list of loads being added to the treatment plant as part of this project to determine new generator and electrical service size requirements.

- Continue to work with process mechanical engineers to further refine list of loads that are required to be on the generator.

- Continue to coordinate with AVISTA (electric utility) to determine if the existing electrical service size needs to be increased to accommodate new loads being added as part of this project.

ES.7.1.3 Geotechnical Engineering

- Are piles necessary beneath some CTP structures to address settlement concerns?
- Can preloading be used to eliminate or reduce the need for piles?

ES.7.1.4 Process Mechanical Engineering

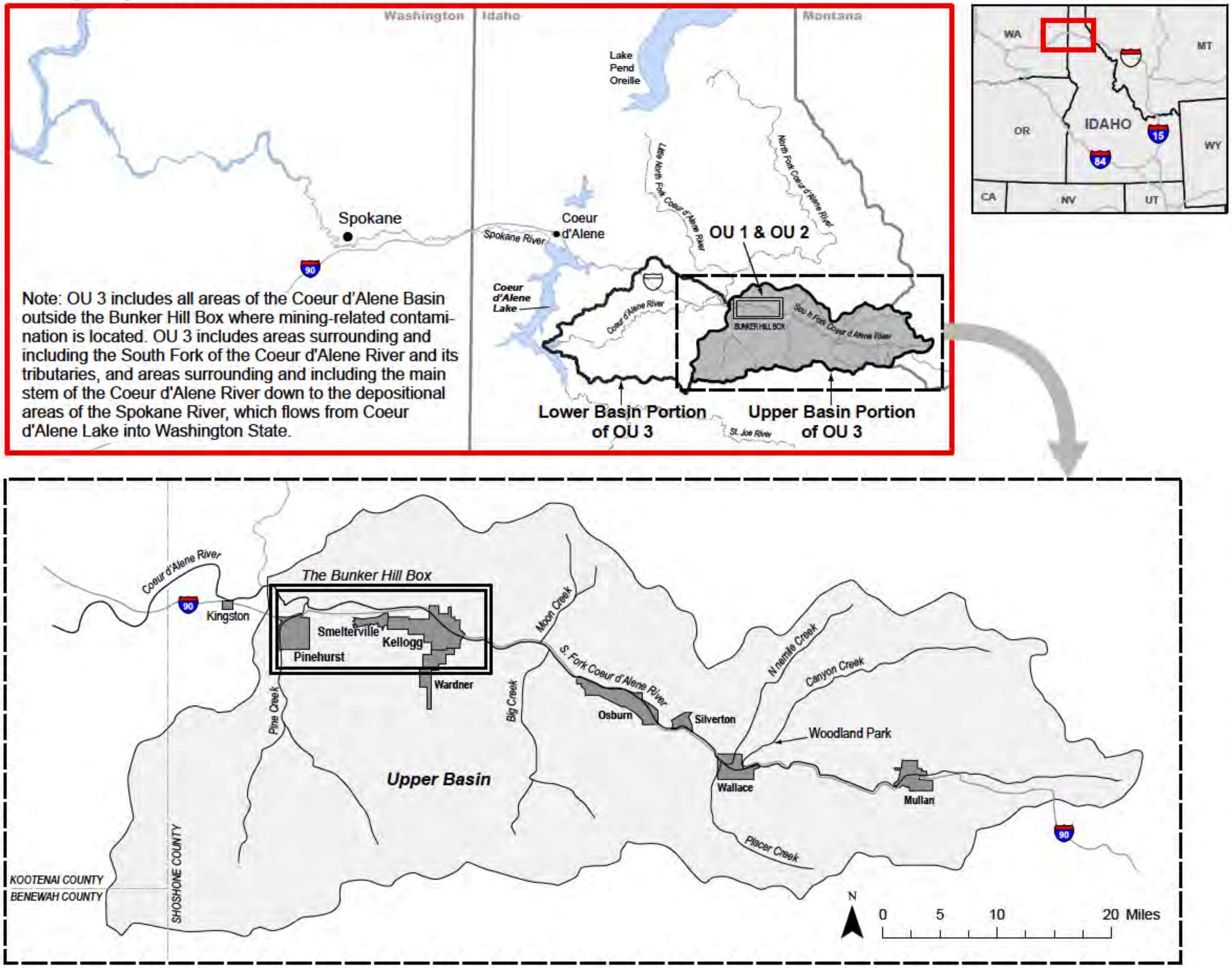
Please refer to Table ES-5.

TABLE ES-5
Process Mechanical Engineering Design Issues

Information Needed to Resolve Design Issue	Applicable Design Issue
Possible Allowance of a Mixing Zone: Indication from USEPA NPDES group about whether a Mixing Zone would be allowed as included in permits for other mines discharging to the SFCDR (25% of upstream flow, with flow tiers). Critical because it might re-define the design treatment goals – e.g., for thallium (Tl), selenium (Se), and whole effluent toxicity (WET).	1. Is specialized Se treatment needed? If yes, what treatment approach would be employed? 2. Is sulfide addition needed for Tl treatment? If yes, what is the best location and possible dose range? 3. Is effluent toxicity likely to be an issue during high flow-strength periods?
Possible NPDES Interim Limits and Compliance Schedule: Input from USEPA NPDES group about the possibility of interim limits and a compliance schedule – e.g., for Tl and Se, to allow time for confirmation data collection and to support future decisions.	Design Issues No. 1 and 2 above.
Possible NPDES variance on pH: Indication from USEPA NPDES group on potential for obtaining variance to increase the upper limit of discharge pH from 9 to 10.	Is an effluent pH adjustment system needed?
Better Understanding of Se in Mine Water: Critical testing by USEPA and CH2M HILL will soon be underway to evaluate whether elevated concentrations of Se exist. The results of this testing could re-define the CTP design influent characteristics and help determine whether specialized treatment for Se is needed.	Design Issue No. 1 above.
The results could also help elucidate Design Issue No. 2. For example, analysis of KT Portal discharge during this year's (relatively mild) high flow/strength period showed that Tl did not exceed ~0.9 ug/L, and this was in absence of any dilution from blending with OU2 groundwater (expected future limit = 0.47 ug/L). These data exhibit virtually no increase from that observed during the pilot study under base flow/strength conditions. With a MZ allowance, it may be possible to forego sulfide addition for Tl treatment.	Design Issue No. 2 above.
Treatment Testing for Se: Needed if the Se investigation results indicate that specialized Se treatment is needed.	Design Issue No. 1 above.
Treatment Testing for Tl: Recommended if filters will be installed, and sulfide addition is needed.	Design Issue No. 2 above
Decision from USEPA on Filters	Will filters be constructed (and when)? During Schematic Design, CH2M HILL will need to start including two sets of drawings to cover 'with and without filters' scenarios.

ES Figures

Vicinity Map of Coeur d'Alene Basin



OU = Operable Unit

Note:
The river corridor portions of the South Fork of the Coeur d'Alene River and Pine Creek located within the Bunker Hill Box are considered to be part of OU 3.

Figure ES-1
Location Map
Record of Decision (ROD) Amendment
Upper Basin of the Coeur d'Alene River
Bunker Hill Superfund Site

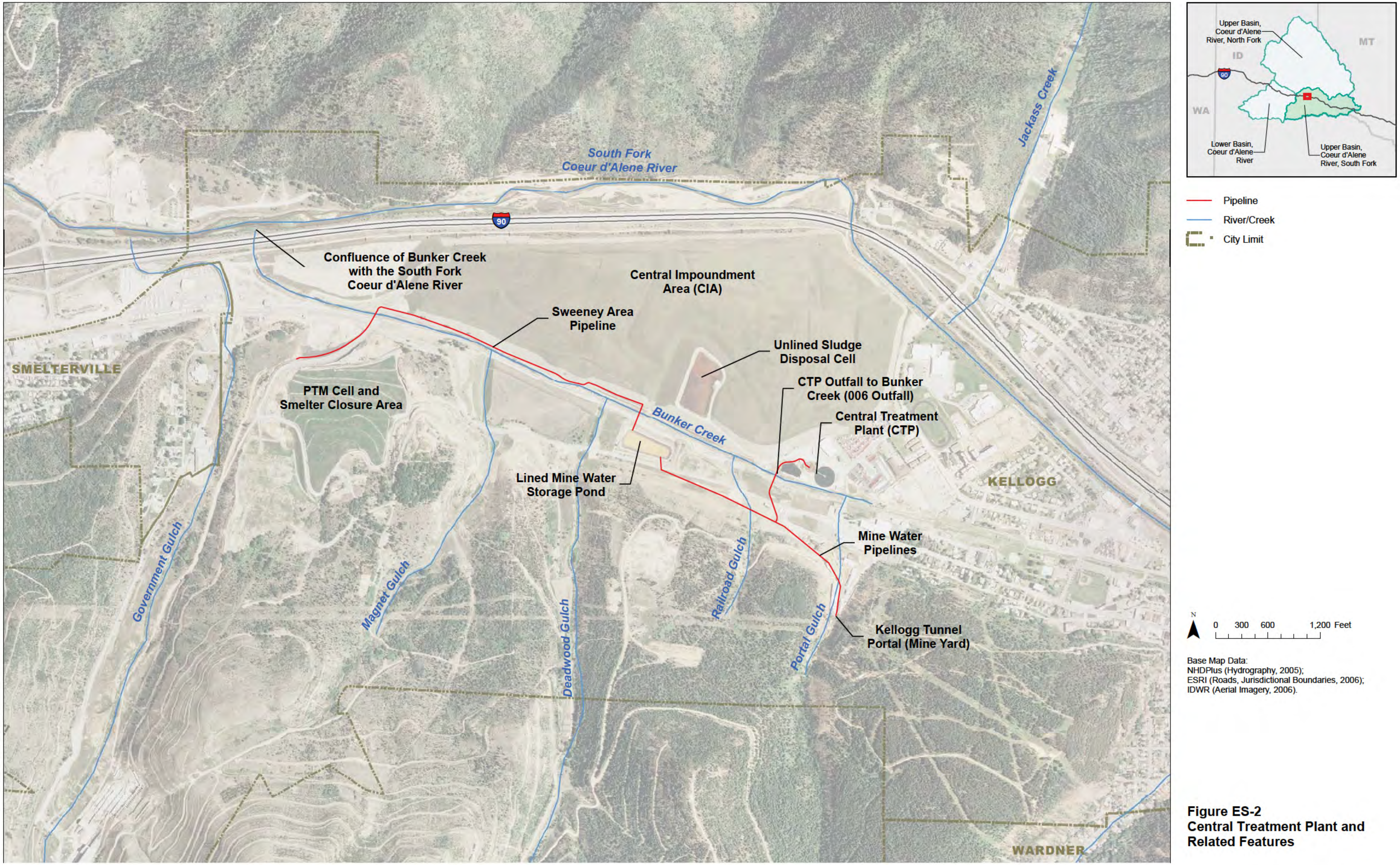


Figure ES-2
Central Treatment Plant and Related Features

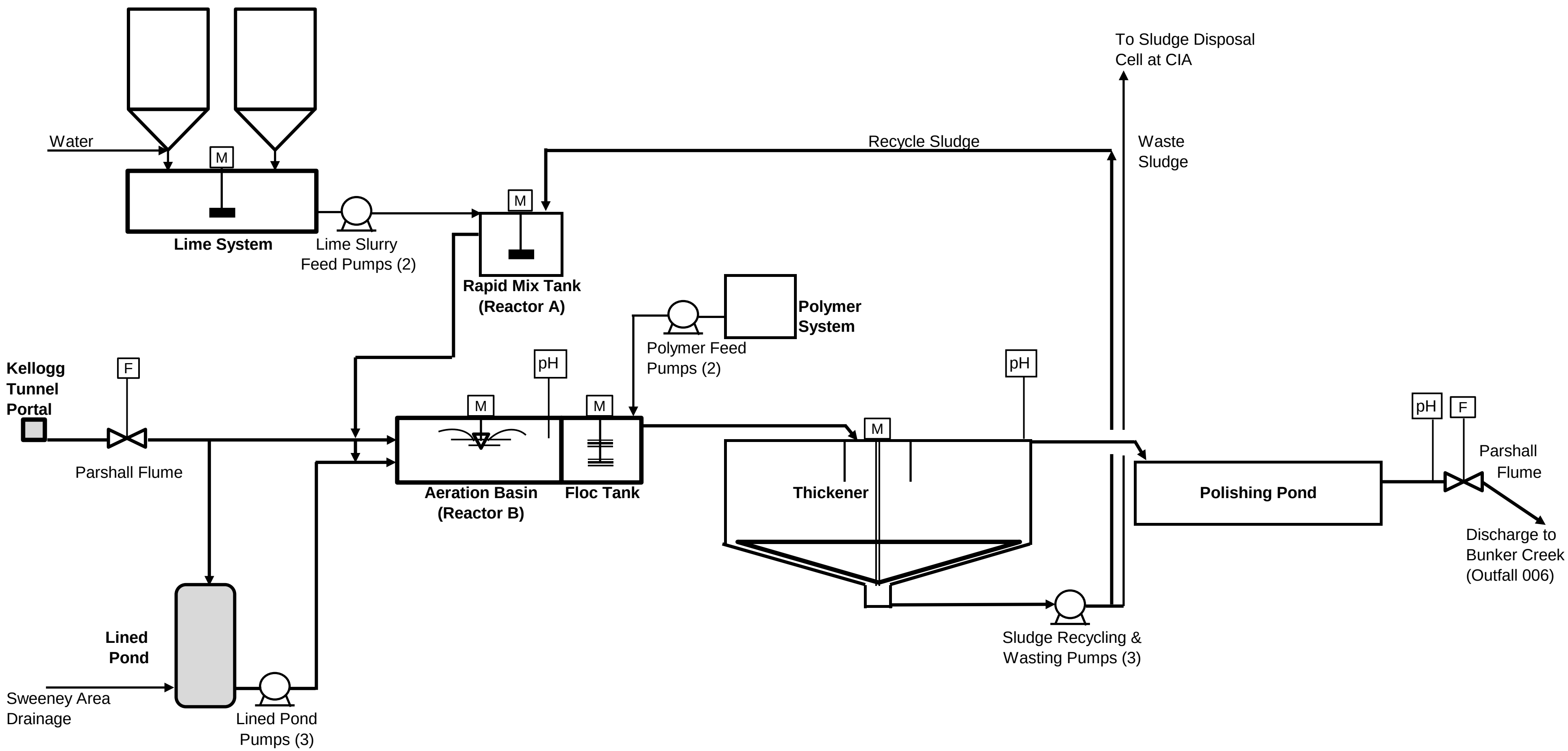
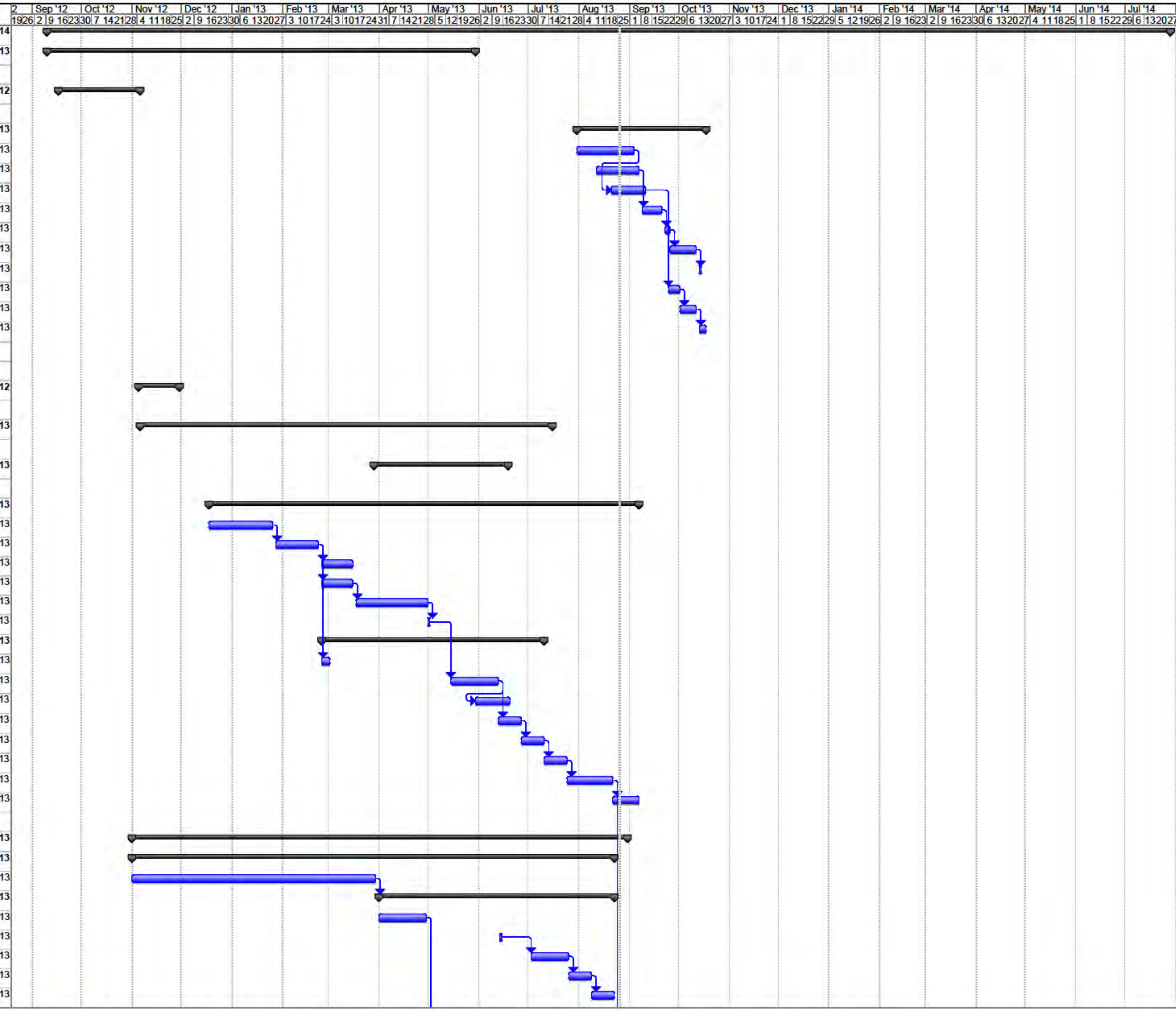


Figure ES-3
Bunker Hill CTP Flow Sheet

CIA Drain RD
Final Design Schedule

ID	Task Name	Duration	Start	Finish
1	CIA Collection and Treatment Remedial Design	480 days?	Mon 9/10/12	Mon 7/28/14
2	Groundwater Modeling	179 days	Mon 9/10/12	Wed 5/29/13
13				
14	Field Work - Fall 2012	36 days	Mon 9/17/12	Mon 11/5/12
24				
25	Supplemental Field Work - Fall 2013	57 days	Wed 7/31/13	Thu 10/17/13
26	Field Planning - Prepare SPAF	25 days	Wed 7/31/13	Tue 9/3/13
27	Subcontractor Procurement - Bid Advertise and Award	20 days	Mon 8/12/13	Fri 9/6/13
28	Coordinate ROE for borings and MWs	15 days	Wed 8/21/13	Tue 9/10/13
29	Subcontractor Mobilization - Geotech	10 days	Mon 9/9/13	Fri 9/20/13
30	Site Reconnaissance. Mark drilling locations. Conduct utility locate.	3 days	Mon 9/23/13	Wed 9/25/13
31	Geotechnical investigation - GWCS Borings	12 days	Thu 9/26/13	Fri 10/11/13
32	Geotechnical investigation - GWCS Test Pits	1 day	Mon 10/14/13	Mon 10/14/13
33	Subcontractor Mobilization - Monitor Wells	5 days	Wed 9/25/13	Tue 10/1/13
34	Hydrogeologic investigation - Drill and Install Monitor Wells	8 days	Wed 10/2/13	Fri 10/11/13
35	Hydrologic investigation -Well development	4 days	Mon 10/14/13	Thu 10/17/13
36				
37				
38	Sample Management	17 days	Mon 11/5/12	Thu 11/29/12
43				
44	Data Management	169 days	Tue 11/6/12	Mon 7/15/13
52				
53	Project Management	57 days?	Fri 3/29/13	Tue 6/18/13
60				
61	GW Collection Preliminary Design	180 days	Tue 12/18/12	Fri 9/6/13
62	Prepare for Jan 25 technical briefing - prelim drain configuration	23 days	Tue 12/18/12	Fri 1/25/13
63	Evaluate Geochemistry Issues - post Jan 25 workshop	20 days	Mon 1/28/13	Fri 2/22/13
64	Evaulate System Hydraulics and Optimize Layout	15 days	Mon 2/25/13	Fri 3/15/13
65	Evaulate Drain Trench and Oxy Minimize Trench Options	15 days	Mon 2/25/13	Fri 3/15/13
66	Final groundwater model simulations and design modifications	32 days	Mon 3/18/13	Tue 4/30/13
67	EPA Briefing	1 day	Wed 5/1/13	Wed 5/1/13
68	Prepare Draft Design Definition Report	95 days	Mon 2/25/13	Wed 7/10/13
69	Prepare Outline	5 days	Mon 2/25/13	Fri 3/1/13
70	Provide minimal internal decision documentation	20 days	Wed 5/15/13	Wed 6/12/13
71	EPA_Corps Comment period -critical comment review	15 days	Thu 5/30/13	Wed 6/19/13
72	Prepare Draft Design Def. for CH2M Internal Review	10 days	Thu 6/13/13	Wed 6/26/13
73	CH2M Internal Review - Fix-up	8 days	Thu 6/27/13	Wed 7/10/13
74	EPA/USACE/DEQ - Technical Review Workshop and Review Period - Draft Design Def	10 days	Thu 7/11/13	Wed 7/24/13
75	Respond to EPA/USACE comments	20 days	Thu 7/25/13	Wed 8/21/13
76	Ajudicate Comments and Prepare Final Design Definition Report	12 days	Thu 8/22/13	Fri 9/6/13
77				
78	CTP Preliminary Design	206 days?	Thu 11/1/12	Fri 8/30/13
79	CTP Pilot Studies and Preliminary Design Review	200 days?	Thu 11/1/12	Thu 8/22/13
80	Pilot_Treatability Studies	99 days?	Thu 11/1/12	Fri 3/29/13
81	Pilot Studies and High Flow Sampling Report	101 days	Mon 4/1/13	Thu 8/22/13
82	Interim Pilot Studies Findings TM	21 days	Mon 4/1/13	Mon 4/29/13
83	EPA/USACE Briefing	1 day	Fri 6/14/13	Fri 6/14/13
84	Draftl Treatability Studies Report	15 days	Wed 7/3/13	Thu 7/25/13
85	EPA/USACE Review	10 days	Fri 7/26/13	Thu 8/8/13
86	Final Treatability Studies Report	10 days	Fri 8/9/13	Thu 8/22/13

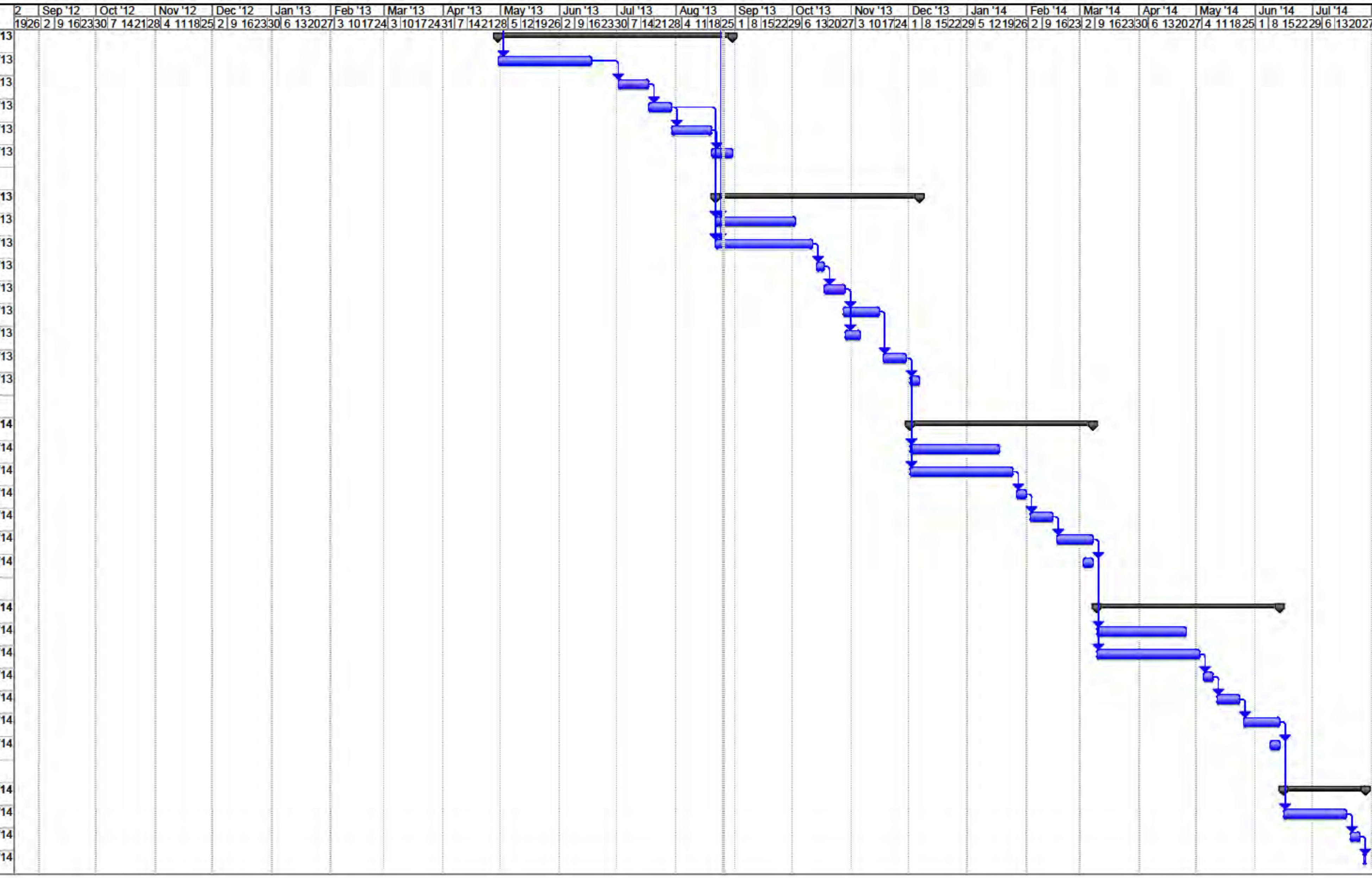


Project: CIA Drain RD
Date: Mon 8/26/13

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

CIA Drain RD
Final Design Schedule

ID	Task Name	Duration	Start	Finish
87	**Project Design Definition (PDD) Report**	**86 days**	**Tue 4/30/13**	**Fri 8/30/13**
88	Draft PDD Report	34 days	Tue 4/30/13	Mon 6/17/13
89	EPA/USACE/DEQ - Technical Review Workshop and Review Period	10 days	Tue 7/2/13	Wed 7/17/13
90	Respond to EPA/USACE comments	8 days	Thu 7/18/13	Mon 7/29/13
91	Ajudicate EPA/USACE Comments	15 days	Tue 7/30/13	Mon 8/19/13
92	Prepare Final Design Definition Report	9 days	Tue 8/20/13	Fri 8/30/13
93				
94	**Integrated CIA GW Collection and CTP Upgrade Schematic Design (SD) - 30%**	**77 days**	**Thu 8/22/13**	**Fri 12/6/13**
95	Prepare Schematic Design Report (30%) for Internal Review -Engineer Cutoff	30 days	Thu 8/22/13	Wed 10/2/13
96	Prepare Schematic Design Report (30%) for Internal Review - CAD Cutoff	37 days	Thu 8/22/13	Fri 10/11/13
97	Compile SDR Package (DM/PAL) and Perform Internal Review	4 days	Mon 10/14/13	Thu 10/17/13
98	CH2M Internal QC Review - Fix-up	7 days	Fri 10/18/13	Mon 10/28/13
99	**Submit SDR for USACE/EPA/DEQ comment review**	15 days	Mon 10/28/13	Fri 11/15/13
100	**SDR Design Review Workshop (target 11/5)**	6 days	Tue 10/29/13	Tue 11/5/13
101	Respond and Ajudicate EPA/USACE Ciomments	10 days	Mon 11/18/13	Fri 11/29/13
102	Prepare Final SDR	5 days	Mon 12/2/13	Fri 12/6/13
103				
104	**CIA Drain Final Design - Integrated with CTP - Design Development Phase - 60%**	**70 days**	**Mon 12/2/13**	**Fri 3/7/14**
105	Prepare DD Plans, Specs and Estimate (60%) for Internal Review - Engineer Cutoff	35 days	Mon 12/2/13	Fri 1/17/14
106	Prepare DD Plans, Specs and Estimate (60%) for Internal Review - CAD Cutoff	40 days	Mon 12/2/13	Fri 1/24/14
107	Compile DD Plans, Specs and Estimate (60%) for Internal Review	5 days	Mon 1/27/14	Fri 1/31/14
108	CH2M Internal Review - Fix-up	10 days	Mon 2/3/14	Fri 2/14/14
109	**Submit DD for USACE/EPA/DEQ comment review and adjudication**	15 days	Mon 2/17/14	Fri 3/7/14
110	**DD Design Review Workshop**	5 days	Mon 3/3/14	Fri 3/7/14
111				
112	**CIA Drain Final Design - Integrated with CTP - Contract Documents Phase - 90%**	**70 days**	**Mon 3/10/14**	**Fri 6/13/14**
113	Prepare CD Plans, Specs and Estimate (60%) for Internal Review - Engineer Cutoff	35 days	Mon 3/10/14	Fri 4/25/14
114	Prepare CD Plans, Specs and Estimate (60%) for Internal Review - CAD Cutoff	40 days	Mon 3/10/14	Fri 5/2/14
115	Compile CD Plans, Specs and Estimate (90%) for Internal Review	5 days	Mon 5/5/14	Fri 5/9/14
116	CH2M Internal Review - Fix-up	10 days	Mon 5/12/14	Fri 5/23/14
117	**Submit CD for USACE/EPA/DEQ comment review and adjudication**	15 days	Mon 5/26/14	Fri 6/13/14
118	**CD Design Review Workshop**	5 days	Mon 6/9/14	Fri 6/13/14
119				
120	**CIA Drain Final Design - Integrated with CTP - Final Fix-Up Phase - 100%**	**31 days**	**Mon 6/16/14**	**Mon 7/28/14**
121	Prepare FX Plans, Specs and Estimate (100%) for Final DM Check	25 days	Mon 6/16/14	Fri 7/18/14
122	CH2M Fix-up Review	5 days	Mon 7/21/14	Fri 7/25/14
123	**Submit Bid-Ready (100%) Contract Documents to USACE/EPA/DEQ**	1 day	Mon 7/28/14	Mon 7/28/14



Project: CIA Drain RD
Date: Mon 8/26/13

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

1 Process Mechanical Design Basis

Phase 1 CTP Upgrades – Project Design Definition

PREPARED FOR: Ed Moreen/USEPA

PREPARED BY: Gary Hickman/CH2M HILL
Nathan Ebbs/CH2M HILL

REVIEWED BY: Jim Mavis/CH2M HILL
Jim Stefanoff/CH2M HILL
Joan Stoupa/CH2M HILL

DATE: August 28, 2013

1.1 Introduction

1.1.1 Purpose and Objectives

This technical memorandum (TM) presents the process design basis for upgrading and expanding the capacity of the Central Treatment Plant (CTP) at the Bunker Hill Mining and Metallurgical Complex Superfund Site (also referred to as the "Bunker Hill Superfund Site" or "the Site"). The scope of the current project is to design facilities to:

- Improve CTP treatment performance to produce effluent water quality in accordance with future discharge limits.
- Increase CTP capacity to accommodate water from a new Central Impoundment Area (CIA) Groundwater Collection System located in Operable Unit (OU) 2, in addition to the Bunker Hill Mine water that is currently treated.

These waters are acidic and contain metals and elements that have been identified as contaminants of concern (COCs) for the Site, including aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, selenium, silver, thallium, and zinc. In the future, the CTP may be further expanded to accommodate contaminated waters collected in the Upper Basin (OU 3) and conveyed to the CTP for treatment. The current project scope does not include Phase 2 expansions; however, provisions will be included in the current design to facilitate future construction, where appropriate.

The CTP Master Plan (CH2M HILL, 2000b) identified four main processing objectives for the upgraded CTP. These were recently re-confirmed and supplemented by the USEPA with two additional objectives (CH2M HILL, 2012b). The objectives for the Bunker Hill CTP upgrade and expansion are:

1. Produce acceptable effluent quality
2. Minimize sludge production
3. Maximize system reliability
4. Incur acceptable capital and operating costs
5. Optimize operation by the commercial sector
6. Maximize sustainability

1.2 Background

1.2.1 Regulatory

The 2001 Mine Water Record of Decision (ROD) Amendment (EPA, 2001) and the 2012 Upper Basin ROD Amendment (EPA, 2012) include remedial actions for collection and treatment of select metals-contaminated source waters within OU 2 and the Upper Basin portion of OU 3 of the Bunker Hill Superfund Site. OU 2 comprises the non-populated areas of the Bunker Hill "Box," a rectangular 21-square-mile area surrounding the former smelter complex. The Upper Basin of OU 3 includes the area of the Coeur d'Alene Basin from the eastern Idaho-Montana border to about one mile west of the confluence of the North Fork and the South Forks of the Coeur d'Alene River, exclusive of the Bunker Hill Box, Figure 1-1. All figures are located in the Figures section at the end of this TM.

The Mine Water ROD Amendment added remedial actions to the Selected Remedy for OU 2 (EPA, 1992) to address the management of acid mine drainage (AMD) from the Bunker Hill Mine. The Mine Water ROD Amendment was necessary, in part, because the CTP (which had not been significantly upgraded since it was built in 1974) was not capable of consistently meeting current water quality standards and the existing sludge disposal area was approaching capacity. Also the OU 2 Selected Remedy included source control actions to reduce the amount of surface water flow into, and AMD flowing out of, the mine. The 2000 CTP Master Plan (CH2M HILL, 2000b) provided technical guidance on the phased implementation of the actions included in the Mine Water ROD Amendment.

The 2012 Upper Basin ROD Amendment (EPA, 2012) clarifies and modifies some of the OU 2 and OU 3 water collection and treatment actions that had been selected in prior RODs for OU 2 and OU 3 (EPA, 1992; EPA, 2002). Overall, the water collection actions focus on intercepting metals-contaminated groundwater and adit discharges emanating from abandoned mining-impacted sites prior to the flows entering into surface water creek and river systems. As described in the 2012 Upper Basin ROD Amendment, some adit discharges were designated for onsite passive or semi-passive treatment, primarily those in relatively remote locations. The collected groundwater and adit seeps not treated onsite were designated for active treatment at the CTP. The current treatment capacity of the CTP is insufficient to accommodate additional OU 2 and OU 3 flows designated for active treatment; therefore, actions to increase the capacity of the CTP are part of the Upper Basin ROD Amendment. In addition to increasing the capacity, CTP upgrades are required to improve treatment effectiveness so that potential future effluent water quality discharge requirements can be achieved, discussed in the Discharge Limits section.

As described in the Upper Basin ROD Amendment, it is expected that upgrade and expansion of the CTP will occur in two phases.

- The first phase includes upgrades to the existing systems to improve efficiency and effectiveness, and provides expanded treatment capacity for contaminated groundwater collected in OU 2 prior to its discharge to the South Fork Coeur d'Alene River (SFCDR).
- The second phase of CTP upgrade and expansion provides additional treatment capacity for OU 3 collected waters.

1.2.2 High Density Sludge Process

The high density sludge (HDS) process is a modification of conventional lime precipitation designed to densify the sludge, reduce the volume of sludge requiring management, and improve sludge dewatering and water filterability. Figure 1-2 is a flow diagram for the basic HDS process developed by Bethlehem Steel, in the late 1960s. Hydrated lime slurry and sludge (recycled thickener underflow) are added to a small, mixed, sludge conditioning reactor (Reactor A) where lime adheres to the recirculated solids. The lime-conditioned solids overflow from Reactor A to a larger, mixed and aerated, neutralization/oxidation reactor (Reactor B) where the influent water is introduced. In Reactor B, the acidity of influent water is neutralized and pH is adjusted to the target for treatment, reduced metals such as Fe[II] and Mn[II]) are oxidized, and these and other metals are precipitated from solution as oxides/hydroxides. The pH of Reactor B is maintained at a chosen set-point (usually in the range of pH 8.5 to 10.5) by controlling lime addition to Reactor A. In the HDS process, precipitates form preferentially on the surface of the lime-coated solids rather than as freely nucleating solids or on equipment surfaces as scale. Moreover, precipitation occurs preferentially on the surfaces of particles comprised of the same metal, primarily because the rate of precipitation is significantly greater when the metal can be incorporated directly into the crystalline structure of the underlying solid. Precipitation reactions of this type are "auto-catalytic" or self-promoting. Repeated recirculation of the solids results in the growth of larger and denser particles compared to those formed by conventional lime precipitation. Reactor B overflows to the thickener where solids/liquid separation occurs. Clarified supernatant (effluent) overflows from the thickener and often is conveyed to a granular media filtration system to remove residual suspended solids. Thickened solids (sludge) are withdrawn as thickener underflow for recycling or wasting. The waste sludge may be dewatered for offsite disposal or transferred directly to an onsite sludge repository. The thickener underflow sludge from an HDS plant typically has a higher percent solids (e.g., 25 percent or higher) compared to that from a conventional lime treatment system (typically 1 to 4 percent solids) resulting in substantially less waste sludge volume that must be managed for dewatering and/or disposal. Also, HDS solids filter and dewater more readily than conventional lime-treatment solids.

1.2.3 CTP

1.2.3.1 History

The CTP was built by the Bunker Hill Mining Company in 1974 to treat AMD from the Bunker Hill Mine, whose main portal is located uphill and south of the CTP. Historically, AMD was stored in an unlined pond on top of the CIA (a large tailings impoundment adjacent to the CTP) before being decanted to the treatment plant. Sludge that formed during the treatment process was disposed of in unlined ponds on top of the CIA.

Ownership of the mine and surface facilities passed through a number of companies during the more than 100 years of the area's mining and mineral processing history. In November 1994, the federal and state governments assumed operation of the CTP when the owner went bankrupt. During the bankruptcy, the New Bunker Hill Mining Corporation (NBHMC) acquired the mine, mineral rights, and land above the mine, but not the CTP. The CTP operated under the direction of USEPA from November 1994 to February 1996 using money from a trust fund established in the bankruptcy.

Also in 1994, USEPA issued a Unilateral Administrative Order to the NBHMC directing the company to:

- Keep the mine pool pumped to an elevation below the level of the SFCDR to prevent discharges to the river.
- Convey mine water to the CTP for treatment unless an alternative form of treatment was approved.
- Provide for emergency mine water storage within the mine.

Since February 1996, the ongoing treatment of AMD and disposal of sludge has been conducted and funded by the federal and state governments. The U.S. Army Corps of Engineers (USACE), under a contract with EPA, currently operates the CTP and associated mine water infrastructure components external to the mine (described below). The NBHMC has not actively mined for several years. USEPA believes that NBHMC has been maintaining the infrastructure of the mine, including the AMD collection ditches within the mine, the mine pool pumping system used to pump water from lower mine workings to the 9 Level (the main operations level, which drains AMD out through the Kellogg Tunnel), and the Kellogg Tunnel itself. USEPA does not have regular access to the interior of the mine to verify the maintenance of internal infrastructure.

1.2.3.2 Mine Water Collection and Treatment System Overview

The overall Bunker Hill mine water collection and treatment system consists of the Kellogg Tunnel (KT) portal system, the mine water pipelines, the Lined Mine Water Storage Pond (Lined Pond), the Sweeney Area pipeline, the CTP, and the unlined Sludge Disposal Cell on the CIA (Figure 1-3). AMD flows from the KT portal into a concrete channel and passes through a Parshall flume where the flow is measured. AMD then enters a buried high-density polyethylene pipeline (Mine Water Pipelines - Main Line), which conveys it either directly to the CTP (via the Direct Feed Branch) or to the Lined Pond (via the Lined Pond Branch), depending on the pipeline valve settings.

The Lined Pond is an approximately 7-million-gallon, lined storage pond for AMD and other site waters. It receives water from the Sweeney Area gravity pipeline Lined Pond, drainage from an old mine water pipeline, and purge water from monitoring well development, as well as Bunker Hill AMD, when it is not conveyed directly to the CTP. The gravity pipeline is constructed to convey water from the principal threat materials [PTM] cell, from below the lead smelter closure area, and from the smelter closure cover toe drain to the Lined Pond. Waters collected in the Lined Pond are periodically pumped to the CTP for treatment.

Of the water treatment sources described above, the mine water flow from the Bunker Hill Mine is by far the largest stream currently treated at the CTP. On average, it comprises about 99 percent of all site waters being treated; the balance includes leachate from waste disposal cells, stormwater from the mine yard, and purge water generated when sampling monitoring wells. The mine water is also the most contaminated water at the Site, it contains the highest concentrations of dissolved metals, requires the most treatment chemicals, and generates the most sludge, on a per-gallon basis.

1.2.3.3 CTP Configuration and Operation

The Bunker Hill CTP is a lime treatment system configured for the HDS process. Figure 1-2 depicts the basic HDS process, while Figure 1-4 depicts the current CTP system. At the CTP, the Rapid Mix Tank is analogous to Reactor A in the HDS process and the Aeration Basin is equivalent to Reactor B. Currently, the CTP does not have post-HDS filtration. Sand filters were installed in 1979 as part of the original CTP system, but they were removed from service and dismantled by the previous CTP operators because of ineffective treatment and high operating cost. Specific performance and operating information for the original filters does not existing, so the exact reasons for their removal are not known; however, they were of an unusual design for this type of application (horizontal pressure filters) and were likely undersized. Nevertheless, there are other existing HDS plants, as well as conventional lime treatment plants, operating at different locations with filters that provide efficient and effective removal of total suspended solids (TSS) from treated mine water (examples include mine water treatment plants at the Resolution Copper Mine in Superior Arizona, and at Argo Tunnel in Idaho Springs, Colorado). Furthermore, pilot testing of granular media filtration at the Bunker Hill CTP demonstrated good performance (CH2M HILL, 2000b). Pilot-scale testing using tri-media gravity filters produced an average total Zn concentration of approximately 15 µg/L (n=3) for filtration of normal CTP effluent (LDS operation) and averages ranging from 22 to 28 µg/L (n=28) for filtration of CTP effluent spiked with sludge to mimic solids loadings representative of HDS operation (compare these concentrations to the expected future monthly average total Zn limit of 244 µg/L, see Table 1-3).

Although originally designed and built as an HDS plant, the CTP is not operated to produce dense sludge. This is intentional because it was found that when operating in HDS mode without filters, carryover of TSS and particulate metals in the thickener effluent prevented the CTP from consistently achieving compliance with current discharge limits for total recoverable metals. This is because, in HDS mode, the solids recycle is substantially increased resulting in appreciably higher solids loading to the thickener. Consequently, the CTP is currently operated in low-density sludge (LDS) mode, with insufficient sludge recycling and sludge inventory in the thickener to produce a high degree of sludge densification. This results in lower effluent TSS and particulate metals concentrations, allowing compliance with current discharge requirements.

In addition to the unit operations shown in the basic HDS flow sheet (Figure 1-2), the CTP has an unused flocculation (floc) basin between the aeration basin and thickener, and a large polishing pond after the thickener. A few, slightly different, configurations have been developed for the HDS process, one of which includes a slow-mix (flocculation) basin to encourage floc formation and growth; however, this is now widely considered to be unnecessary for HDS systems. At the CTP, the Floc Basin, which originally featured a slow-speed paddle-type stirrer, was determined to be unnecessary and was taken out of service[2]. The CTP upgrade design will not include a flocculation basin.

The Polishing Pond at the CTP was originally constructed as a storage reservoir to allow the use of process water (treated effluent) for ore processing. Treated effluent from the

[2] The Floc Basin mixer was shut down circa 1997 on CH2M HILL's recommendation. The CTP operator was adding polymer flocculant after, rather than before, the Floc Basin, because it had been determined that better solids flocculation and clarification were achieved by that approach.

Polishing Pond is now sometimes used for lime slaking and lime slurry dilution, as well as for polymer makeup. CH2M HILL has recommended that City water be used for lime makeup to avoid forming gypsum (with sulfate in effluent), resulting in inefficient lime utilization. While some small amount of suspended solids might settle out in the Polishing Pond (no data exist to evaluate this), it serves little or no purpose for treatment at the CTP.

Treated effluent is discharged from the Polishing Pond to Bunker Creek. Waste sludge is pumped to the unlined sludge disposal cell, on top of the CIA, for dewatering and disposal.

1.2.4 Status of CTP Upgrades Included in 2001 Mine Water ROD Amendment

As discussed previously, the Mine Water ROD Amendment included actions to upgrade the CTP to consistently achieve discharge requirements for treatment of Bunker Hill mine water. While some components of the Mine Water ROD Amendment have been implemented by USEPA and the State of Idaho, others have not. The following improvements were implemented as part of the time-critical actions taken to replace the most failure-prone equipment and plant systems.

2002 Constructed the direct feed branch of the mine water pipelines to provide gravity flow of AMD directly to the CTP, bypassing the Lined Pond.

2003 Refurbished the thickener.

2003 Increased the hydraulic capacity to 5,000 gpm by replacing the thickener launder drop box and pipeline between the thickener and polishing pond.

2004 Constructed a new waste sludge pipeline from the CTP to the Sludge Disposal Cell atop the CIA.

2004 Replaced and upgraded the lime storage, makeup, and feeding system.

2005 Constructed a new gravity-flow pipeline from the Sweeney Area to the Lined Pond to replace the old Sweeney/004 pipeline and pump station.

2006 Constructed a new Control Building and updated the plant control system, including new alarm systems.

2006 Updated the plant electrical system.

2006 Installed a new CTP control system.

2006 Installed a backup diesel/electrical generator and sound-deadening enclosure.

2006 Installed one new sludge recycle pump to replace a pump that had failed.

The following Mine Water ROD Amendment items have not yet been implemented:

- Replace the existing rapid mix tank with a new, properly designed Reactor A (Sludge Conditioning Reactor) and mixer.
- Replace the existing aeration basin with a new (one or more), properly designed Reactor B (Oxidation and Neutralization Reactor), mixer, aeration system, and blower.

- Replace the existing manual polymer makeup system and associated pumps and pipes with an automated polymer makeup and feed system.
- Replace the sludge recycle and wasting pumps that were not replaced in 2006.
- Add an influent (KT Portal) flow meter with an element and transmitter that communicates with the CTP control system.
- Construct the West Fork Milo Creek diversion, and implement other source control measures (rehabilitate the Phil Sheridan Raise and plug in-mine drill holes), to reduce Bunker Hill mine AMD peak flows and strength.
- Add a granular media filtration system, including a new filter building, filters, clear well tank, pumps, and piping, with 2,500 or 5,000 gpm capacity, depending on whether the West Fork Milo Creek diversion is implemented. ***Note: the flows mentioned here are consistent with the 2001 Mine Water ROD Amendment, but higher flows are now under consideration for the current CTP upgrade and expansion design because additional flow from the CIA Groundwater Collection System will be included for treatment at the CTP.***

1.3 Design Flows and Concentrations, and Discharge Limits

1.3.1 Design Influent Flows

The Upper Basin ROD Amendment (EPA, 2012) identifies remedial actions that will collect additional flows from source areas in OU 2 and OU 3, these actions are expected to be implemented in phases. The first phase, which is the subject of the current design project, will upgrade and expand the CTP to accommodate the current CTP influent plus the additional flow of OU 2 water from the CIA Groundwater Collection system. Table 1-1 presents the presumptive design flows for the Phase 1 improvements. The selected design flows span a range from base flow to maximum flow conditions, representing flows encountered in late-summer through winter and during spring runoff, respectively.

Future phases would add additional waters to the CTP influent from OU 3 flows that are collected and conveyed to the CTP for treatment. Potential OU 3 waters for future collection and treatment at the CTP are listed elsewhere (CH2M HILL, 2012a, 2012b). The current design project will consider the possible future CTP flows and incorporate provisions for accommodating them in a future phase, where practical and cost-effective.

TABLE 1-1
Presumptive Design Influent Flows

Source	Units	Base Flow Conditions	Max Flow Conditions
Bunker Hill Mine Water	gpm	1,300[a]	5,000[a]
OU 2 Groundwater from CIA Collection System	gpm	2,000[b]	3,000[b]
Total	**gpm**	**3,300**	**8,000**

gpm = gallons per minute

[a]1,300 gpm is the approximate average mine water base flow to the CTP. 5,000 gpm is the current nominal

TABLE 1-1
Presumptive Design Influent Flows

Source	Units	Base Flow Conditions	Max Flow Conditions

maximum design flow for the CTP; any flow above that must be diverted to either the Lined Pond or the mine pool for temporary storage.

[b]2,000 gpm is the average value predicted by mathematical modeling of the system (assuming both base flow and 90th percentile flow in the SFCDR); 3,000 gpm is based on modeling sensitivity analysis and a safety factor for design.

1.3.2 Design Influent Characteristics

The COCs in Bunker Hill Mine water, currently the primary influent source to the CTP, were identified in the baseline risk assessment performed for the RI/FS (CH2M HILL, 2001) as: aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury, selenium, silver, thallium, and zinc. The CTP operator routinely measures selected parameters (cadmium, lead, manganese, zinc, pH, and TSS) in CTP influent and effluent, but little historical data exist for other constituents in Bunker Hill Mine water, with the exception of a data set collected in 1998-99. For Bunker Hill Mine water, peaks in strength tend to correspond with peaks in flow because during high snowmelt/runoff periods water percolating through the mine flushes pore spaces where acid-forming reactions have been occurring since the last flushing event, thereby mobilizing acidity and dissolved metals.

A recently-completed pilot study, conducted from November 2012 to March 2013, provided a fairly rigorous set of data for Phase 1 CTP influent during base flow/strength conditions (Bunker Hill Mine water strength tends to be increase at high flows). The influent for one of the pilot plants involved in that study was comprised of a blend of Bunker Hill Mine water and OU 2 groundwater approximating the Phase 1 CTP influent under base flow/strength conditions[3]. These data were used to establish the assumed design influent characteristics for base flow/strength conditions. Design data for maximum flow/strength conditions could not be obtained directly because the pilot study was not conducted during the high-flow period and the flow and strength of mine water vary considerably from year to year (for instance, 2013 was a relatively mild runoff year, with a relatively low snowpack and the absence of heavy rains during the snowmelt period). Therefore, the assumed design influent characteristics for maximum flow/strength conditions were developed based on the 1998-99 data.

Table 1-2 presents assumed design influent characteristics for base and maximum flow/strength conditions, based on pilot study data and maximum monthly values calculated from the 1998-99 data, respectively. The characteristics of the maximum flow conditions assumed for design do not represent the absolute worst case mine water quality that is expected to occur. However, it is expected that occurrences of worse water quality discharge from the mine will be infrequent and short-lived, as supported by past experience.

[3] The blend used for this pilot study influent was 34 percent mine water and 66 percent OU 2 groundwater (by volume), which is slightly different from the proportions obtained using the design flow data in Table 1-1 (39 percent mine water and 61 percent groundwater). Thus, it is likely that the pilot study influent concentrations were lower than CTP influent under base flow conditions, but only slightly. The reason for this discrepancy is that the conceptual design for the CIA Collection System and associated groundwater modeling predictions were revised after the pilot study was underway.

The lime system at the CTP is designed with the capacity to treat higher strength water than that assumed for the maximum flow condition, so stronger influent water during peak flow/strength periods will still be effectively neutralized and treated for metals removal. Operational constraints under extremely high flow/strength conditions might result in a temporary decrease in thickener underflow (TU) percent solids concentrations. During such conditions, the volume of sludge wasted to remove a given mass of solids from the system would be greater than for a higher TU percent solids concentration. However, these conditions are expected to be infrequent and short-lived, so the incremental increase in waste sludge volume would be minor compared, for instance, to the annual volume of waste sludge produced.

TABLE 1-2
Design Influent Characteristics

Parameter	Units	Base Flow/Strength Conditions[a]	Max Flow/Strength Conditions[b]
pH	std units	3.67	2.65
Conductivity	mS/cm	1.42	2.83
Alkalinity	mg/L as $CaCO_3$	1.5 U	1.5 U
Hardness	mg/L as $CaCO_3$	670	730
Sulfate	mg/L	720	1,700
TDS	mg/L	1,180	2,700
Dissolved Metals			
Aluminum	µg/L	820	10,300
Arsenic	µg/L	8.3	810
Cadmium	µg/L	70	490
Calcium	µg/L	144,000	138,000
Copper	µg/L	38	870
Iron	µg/L	5,700	231,000
Lead	µg/L	160	240
Magnesium	µg/L	70,500	107,000
Manganese	µg/L	33,200	77,500
Mercury	µg/L	0.0008	0.58
Selenium	µg/L	2.5	13[c]
Silver	µg/L	1.8	14
Thallium	µg/L	0.72	30
Zinc	µg/L	36,600	177,000

mg/L = milligrams per liter
µg/L = micrograms per liter
mS/cm = milliSiemens per centimeter

TABLE 1-2
Design Influent Characteristics

Parameter	Units	Base Flow/Strength Conditions[a]	Max Flow/Strength Conditions[b]

TDS = total dissolved solids

[a]Overall average during the 2012-13 pilot study

[b]Max Month (maximum monthly average) values calculated from 1998-99 data for use in the pilot study (calculation procedure is described in the pilot study report [CH2M HILL, 2013]).

[c]There is some uncertainty about the accuracy of elevated selenium concentrations in old data sets (see Selenium Treatment Challenge section below).

1.3.3 Discharge Limits

The CTP currently operates under discharge limitations established by an NPDES permit that was issued in 1986 and expired in 1991. Expected future discharge limits were evaluated for USEPA in 2002, and the evaluation was revised in 2007 (CH2M HILL, 2002, 2007b). Table 1-3 presents the current effluent discharge limits for the CTP and the expected future limits. The new limits for metals/elements are lower than the current CTP effluent limits and they include several previously unregulated metals and elements (aluminum, arsenic, iron, manganese, selenium, silver, and thallium). Preliminary discussions with USEPA Office of Water and Watersheds indicate that discharge of manganese probably would not be regulated to limits as low as those shown in the table because the underlying basis for those values may not be appropriate[4]. In addition, Whole Effluent Toxicity (WET) trigger values, based on acute and chronic bioassay testing using the water flea (*Ceriodaphnia dubia*) and fathead minnow (*Pimephales promelas*) will likely be included in a new discharge permit, in accordance with 40 CFR 122.44(d)(1)(iv), which states that "When the permitting authority determines…that a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the numeric criterion for whole effluent toxicity, the permit must contain effluent limits for whole effluent toxicity."

TABLE 1-3
Current and Expected Future CTP Effluent Limits (not considering any mixing zone)

		Current Limits[a]		Expected Future Limits[b]	
Parameter	Units	Daily Maximum	Daily Average	Daily Maximum	Monthly Average
Arsenic	µg/L	--	--	101	50
Cadmium	µg/L	100	50	5.6	2.8
Copper	µg/L	300	150	63.5	31.7
Lead	µg/L	600	300	171	85.2
Mercury	µg/L	2	1	0.020	0.010

[4] The current National Recommended Water Quality Criteria table (online version) does not include a manganese value for protection of aquatic life, but cites 50 and 100 µg/L for protection of human health for consumption of water+organism and organism only, respectively. However, the 50 µg/L value is based on aesthetic considerations (laundry staining, objectionable taste) rather than toxic effects, while the 100 µg/L value is based on the 1976 "Red Book" value for protection of consumers of marine mollusks, which do not occur in the Coeur d'Alene River Basin. Consequently, the applicability of these limits is uncertain.

TABLE 1-3
Current and Expected Future CTP Effluent Limits (not considering any mixing zone)

		Current Limits[a]		Expected Future Limits[b]	
Parameter	Units	Daily Maximum	Daily Average	Daily Maximum	Monthly Average
Selenium	µg/L	--	--	8.2	4.1
Silver	µg/L	--	--	43.9	21.9
Thallium	µg/L	--	--	0.94	0.47
Zinc	µg/L	1,480	730	489	244
Aluminum	µg/L	--	--	143	71.2
Iron	µg/L	--	--	1,643	819
Manganese	µg/L	--	--	164[c]	81.9[c]
pH	std units	6.0–10.0		6.5–9.0	
TSS	mg/L	30	20	30	20
Dissolved Oxygen	mg/L	--	--	>6	
Temperature	°C	--	--	≤22	≤19
Whole Effluent Toxicity	TU_c	--	--	≤1.0	

°C = degrees Celsius
TSS = total suspended solids
TU_c = toxic units, chronic

[a] Metals limits are as total metal. Daily monitoring of copper and mercury is not required.

[b] All metals are expressed in terms of total recoverable metal except for mercury, which is in terms of total metal.

[c] As noted in Footnote 2, future limits for manganese are uncertain, but are expected to be higher than the values shown.

Sources: Current limits – CH2M HILL, 2002 (from National Pollutant Discharge Elimination System Permit No. ID 000007-8, expired October 1991); expected future limits – CH2M HILL, 2007.

Three factors that could potentially affect the implementation of the expected future discharge limits are:

1. variances/waivers for specific chemical parameters or use of alternate WET test species;
2. a mixing zone allowance for the effluent discharge; and
3. a compliance schedule/interim limits.

These possible "mitigative measures" were discussed in a teleconference between EPA, USACE, and CH2M HILL on August 12, 2013, and the supporting information prepared by CH2M HILL from the teleconference is included in Attachment 1-B.

1.4 Process Basis of Design

1.4.1 Overview

Table 1-4 summarizes key design data used to support the design. Table 1-5 provides an overview of upgrades to the CTP that would be necessary in Phase 1 (scope of the current design) and Phase 2, to accommodate selected OU 2 and OU 3 waters, respectively. The existing thickener and the relatively new automated lime system are adequately sized to accommodate the expected Phase 1 flows under most conditions, although temporary storage of some water may be required under short-term, worst-case conditions during periods of exceptionally high mine water flow (e.g., if mine water flow exceeded 5,000 gpm, or if the total influent flow exceeded 8,000 gpm). Most of the other CTP components would be replaced with new equipment.

A preliminary process flow diagram (PFD) for the upgraded and expanded CTP is included in the Drawings section at the end of this TM. Figure 1-5 presents a preliminary flow and solids balance for the upgraded and expanded CTP operating in HDS mode. Tables A-1 through A-3, in Attachmebnt 1-A, show preliminary sizing for new vessels, pumps, and mixers and blowers associated with the CTP upgrades.

TABLE 1-4
Summary of Key Design Data

Parameter	Units	Flow/Strength		Notes
		Base	Max	
Influent Parameters				
Influent flow	gpm	3,300	8,000	Basis described in Table 1-1.
Lime demand (LD) at pH 10	g/L as $Ca(OH)_2$	0.206	1.40	Calculated from pilot study LD data and design flows (calculations in Pilot Study report). ***Existing lime system max feed rate = 160 lb CaO/min, or 20 lb CaO/Kgal at 8,000 gpm influent flow. Existing system capacity is adequate.***
	Lb/Kgal as $Ca(OH)_2$	1.72	11.7	
	g/L as CaO	0.156	1.06	
	lb/Kgal as CaO	1.30	8.84	
Solids formed (SF) at pH 10	g/L	0.225	1.67	Calculated from pilot study SF data and design flows (calculations in Pilot Study report).
	lb/Kgal	1.88	13.9	
Iron [II] concentration	mg/L	41	326	Calculated from pilot study Fe and Mn data and design flows (calculations in Pilot Study report).
Manganese [II] concentration	mg/L	47	107	
Oxygen demand (transferred)	lb/min	0.54	5.2	Stoichiometric calculations from influent Fe[II] and Mn[II] loads.
Parameter	**Units**	**LDS**	**HDS**	**Notes**
Process Parameters				

TABLE 1-4
Summary of Key Design Data

Parameter	Units	Flow/Strength		Notes
		Base	Max	
Reactor A target HRT	min	1 – 5		Based on process experience.
Reactor B target HRT (total)	min	20 - 40		Based on process experience. Pilot testing data indicated an HRT of ~30 min yielded good Mn oxidation at the pH values used.
Reactor B treatment pH	std units	10.7	10.2	From pilot study, for effective treatment of specific metals/elements, such as manganese and thallium. Optimization during full-scale operation is recommended.
Thickener unit area requirement (Base/Max conditions)	ft^2/(ton/d)	14/56	11/7.2	From pilot study Talmadge-Fitch test data.
Thickener diameter requirement (Base/Max conditions)	ft	30/211	36/105	Based on unit area requirements, SF, and influent flow. ***Existing thickener diameter = 236 ft. Size is adequate.***
Thickener HRT requirement (Base/Max conditions)	min	180/225		From pilot study Dorr-Oliver test data.
Thickener volume requirement	MG	0.59/1.8		Based on HRT requirements. ***Existing thickener volume ~3.3/4.4 MG (excluding/including cone bottom). Size is adequate.***
Solids recycle ratio	wt/wt	10:1	20:1	Pilot study evaluated SRRs of 6, 12, 24, and 48:1, but recommend limiting HDS SRR to ~20:1 limit TU %solids unless a thickener rake is installed.
TU percent solids	wt %	11.5	25	From pilot study data. Pilot TU reached 35 percent solids in HDS operation at SRR of 24:1, but recommend constraining to ~25% unless rake lift is installed.
Dry solids specific gravity	g/mL	2.5	3.0	From pilot study data
Dewatered sludge percent solids	wt %	17	35-40	From BF testing data; assume constraining TU % solids as mentioned above would limit dewatered %solids value to lower than pilot study results.
Polymer type		Z-Floc 571		Currently, used at CTP; Magnafloc 338 also effective. Full-scale optimization is required.

TABLE 1-4
Summary of Key Design Data

Parameter	Units	Flow/Strength		Notes
		Base	Max	
Polymer dose	mg/L	0.5 – 3.0		From pilot study data and experience. Full-scale optimization is required.
Sulfide addition				Pilot study results indicate this would likely be required to reliably meet expected future thallium limit, particularly during high-strength periods.
Sulfide addition point				Reactor B (tested in pilot study) or Filter Feed sump (potentially better alternative, if filters are installed).
Sulfide dose	mg/L	1 – 50		From pilot study results. Full-scale optimization is required.
Granular media filters				Pilot study data indicate filters would be required to reliably meet expected future discharge limits for metals/elements and aquatic toxicity, if/when they become in effect, regardless of LDS or HDS operation. Filters also required for HDS operation with current discharge limits.
Filter target loading rate	gpm/ft^2	3 – 5		From process experience and pilot study results indicating need for conservative filter design.

HRT = hydraulic retention time; TU = thickener underflow
ft = feet
$ft^2/(ton/d)$ = square feet of surface area per tons/day of solids loading
g/L = grams per liter
g/mL = grams per milliliter
gpm/ft^2 = gallons per minute per square feet of surface area
lb/Kgal = pounds per 1,000 gallons
lb/min = ponds per minute
MG = million gallons
min = minutes
wt % = weight percent
wt/wt = weight ratio

1.4.2 Process Design Elements

1.4.2.1 Influent Systems

Future influent to the CTP will consist of mine water via the Direct Feed Branch of the Mine Water Pipelines, groundwater via the new pipeline from the CIA Groundwater Collection System, and/or stored water from the Lined Pond. These are the raw water sources for the current Phase 1 upgrade project. A future Phase 2 upgrade project would add mining-influenced water from OU 3 sources to the Phase 1 waters. It is expected that flows from OU 3 may be substantial and require a second train of treatment reactors, which would be constructed parallel to the one constructed for Phase 1 (provisions for this future construction will be made in the Phase 1 design).

All influent waters are conveyed to Reactor B for treatment. If a second reactor train is constructed in the future, a flow-splitting system will be required to blend and divide influent waters between the two trains. Provisions for this will be incorporated in the present design, as appropriate and practical. For example, these provisions could include routing influent pipelines in a centralized location between the current and future trains and including pipe stubs for future connections. However, because of the uncertainty about possible future OU 3 flows, pipeline size, the timing of a Phase 2 project, etc., it may not be practical to do any extra construction to accommodate OU 3 influent, at this time.

The mine water pipelines require periodic cleaning to remove principally iron oxyhydroxides that precipitate en route to the CTP or Lined Pond. For this reason, the Mine Water Pipelines were constructed with pigging and camera stations. They are normally pigged twice per year and this maintenance routine has proven effective at keeping pipelines free-flowing and preventing sludge/scale accumulation. The current design will include a system for capturing cleaning pigs at the new B Reactors, since the existing pig catcher box will be demolished along with the existing Aeration Basin. The pig launching vaults on the Mine Water Pipelines are adequate and will be retained.

It is expected that the new CIA Groundwater Collection Pipeline will require periodic cleaning and the design will include provisions for this.

TABLE 1-5
Overview of CTP Upgrades Required to Treat Additional OU 2 and OU 3 Waters

CTP Component	Upgrade Not Necessary	Phase 1 Upgrade (OU 2 waters)	Phase 2 Upgrade (OU 3 waters)	Comments
Sludge Conditioning Reactor (Reactor A)		X	X	One new Reactor A installed in Phase 1 (sized for the Phase 1 design flow). A second new Reactor A installed in Phase 2 (sized for the incremental Phase 2 flow).
Oxidation/Neutralization Reactor (Reactor B)		X	X	A new Reactor B, configured as two vessels in series, installed in Phase 1 (sized for the Phase 2 design flow). A second pair of B Reactor vessels installed in Phase 2 (sized for the incremental Phase 2 flow).
Polymer System		X		A new automated polymer makeup, storage, and feed system installed in Phase 1. Ideally, this would be able to accommodate Phase 2 flows.
Thickener Tank	X			The existing thickener tank is adequate for the expected Phase 1 and 2 flows, under most conditions.
Thickener Rake	X			The existing thickener rake and drives are adequate for the expected Phase 1 and 2 flows. A rake lift is preferred, but not required.
Thickener Discharge Launder, Drop Box, and Feedwell		X		The existing thickener effluent launder and drop box, and perhaps the feedwell, upsized during Phase 1 to accommodate expected Phase 1 flows. Ideally, these improvements would also accommodate Phase 2 flows.
Filtration System[a]		X	X	A new granular media filter system, with capacity installed as needed for Phase 1 and 2 flows. Includes a new Filter/Effluent building, water sumps (filter feed, clearwell, dirty backwash), pumps, and filter vessels.
Effluent Discharge System		X	X	A new effluent discharge system designed to discharge CTP effluent directly to the SFCDR (replacing the existing outfall to Bunker Creek). Installed in Phase 1, but would include provisions for accommodating upgrades in Phase 2. Includes pH adjustment system, effluent monitoring station, pumps, pipeline, and outfall.
Control Building	X			The existing control building is adequate for use with Phase 1 and 2 upgrades.
Lime System	X			The existing lime system is adequate for the expected Phase 1 and 2 flows, under most conditions.
Sludge Recycle and Wasting Pumps		X	X	New sludge recycle and wasting pumps installed as needed for Phase 1 and 2.
Sulfide Addition System		X		A new system for storing sulfide chemical (e.g., NaHS), making up sulfide solution, and metering sulfide solution for enhanced treatment of thallium and possibly other metals.
Effluent pH Adjustment System		X	X	A new system for storing and adding acid to treated effluent to lower pH to within discharge limits, if needed, for Phase 1 and 2 (assuming two separate effluent pipelines).
Piping		X	X	New piping associated with upgrades installed as needed for Phase 1 and 2.
Electrical		X	X	New electrical associated with upgrades installed as needed for Phase 1 and 2 (see Electrical Loads and Design Criteria, TM 4), including a new motor control center (MCC) and new

TABLE 1-5
Overview of CTP Upgrades Required to Treat Additional OU 2 and OU 3 Waters

CTP Component	Upgrade Not Necessary	Phase 1 Upgrade (OU 2 waters)	Phase 2 Upgrade (OU 3 waters)	Comments
				standby power generator.
Instrumentation & Controls		X	X	New I&C associated with upgrades installed as needed for Phase 1 and 2 (see Instrumentation & Control Concepts, TM 5).
Equipment decommissioning and demolition		X	(X)	Decommissioning and demolition of the existing Rapid Mix Tank, Aeration Basin, Floc Basin, Polymer System, polishing pond, Effluent Monitoring Shed, piping, and pumps.

[a]The need for, and timing for implementation of, a filtration system will be determined during the design process, and design will provide provisions for inclusion/deletion as necessary.

1.4.2.2 Reactors

Reactor A is a small mixed reactor that receives recycled sludge and lime slurry and discharges to Reactor B. Reactor A will be situated on a stand above and roughly between the two Reactor B tanks and will include provisions to discharge to either of the two Reactor B tanks. Reactor A is preliminarily sized at 464 gallons (gal) (approximately 4.5-foot [ft] in diameter by 7.5-ft tall) to provide a hydraulic retention time (HRT) ranging from 0.5 minutes (min) at maximum flow to 8 min at base flow. These HRT values are outside of CH2M HILL's normal design range of 1-5 min, but they represent a compromise for the wide flow range. The purpose of the "normal design range" for Reactor A HRT is to provide enough time for good contact between the recycled sludge particles and lime, but not so much time that it slows the pH feedback response unnecessarily (like in the very large, existing, Rapid Mix Tank). It is expected that the short HRT at the maximum flow condition will be relatively infrequent and short-lived. The drawback of a long HRT is slower pH response time, but it is expected that influent water pH will be relatively consistent during base flow conditions, and therefore will not require dramatic adjustments. This reactor will be an open-topped, cylindrical, coated steel tank, equipped with a bridge-mounted mechanical mixer and fitted with vertical baffles to disrupt vortexing and enhance mixing. The existing lime slurry loops will need to be modified to deliver the lime slurry to the new Reactor A, as will the existing sludge recycle line.

Reactor B is a larger mixed and aerated reactor that receives influent water (mine water and OU 2 groundwater) and lime-conditioned sludge that overflows from Reactor A and discharges to the thickener. CH2M HILL recommends configuring Reactor B as two equally sized tanks, in series, to provide greater flexibility for accommodating a wide range of flows, as well as, allowing for easier maintenance. Using two tanks in series allows for potentially better treatment performance and effluent quality by moving the reaction regime from a completely mixed system to partially plug-flow. The Reactor B tanks are preliminarily sized at 140,000 gal each (approximately 32-ft diameter by 28-ft tall) to provide HRTs of 30 min during maximum flow (using both tanks in series) and 40 min during base flow (using only one tank). Both of these HRTs are within CH2M HILL's normal design range of 20-40 min. These reactors will be open-topped, cylindrical, coated steel tanks, equipped with bridge-mounted mechanical mixers, fitted with vertical baffles to disrupt vortexing and enhance mixing, and aerated with diffused air. Also, the B Reactors will be fitted with an effluent upcomer or baffled-off section where the pH element for process (lime feed) control is positioned. It is expected that the aeration blowers will be located in a conveniently positioned building that also houses the new polymer and sulfide systems. Polymer flocculant will be added to Reactor B effluent, downstream from the pH element to avoid fouling, to enhance settling in the thickener. A platform will be needed to access the top of the new Reactor B tanks, and the new Reactor A. Piping requirements include influent piping, inter-reactor connector piping, reactor bypass piping, and connection to the thickener feed pipe.

1.4.2.3 Thickener

As previously mentioned, the thickener vessel is adequately sized to accommodate the projected future flows; however, some modification of internal features may be required. In particular, upsizing of the thickener feed pipe, feedwell, effluent launder, and/or effluent drop box may be needed for the higher flows. Inquiries about these features have been submitted to FL Smidth, the company that owns Eimco, the original manufacturer of the CTP thickener. CH2M HILL has communicated with, and requested information from, the FL Smidth engineers who oversaw the CTP thickener repairs and modifications in 2003.

Although the existing thickener experiences periodic wind perturbations, as supported by visual observations, the resulting increase in thickener effluent TSS is relatively low. For example, a review of the CTP discharge monitoring reports (DMRs) for the first 6 months of 2013 indicates that the maximum measured TSS was 3 mg/L. While this is a relatively low concentration, the pilot study results indicate that this could be unacceptable for compliance with expected future discharge limits (e.g., for total zinc), without filters (see filter discussion in Attachment 1-B). One of the main reasons for including filters in the CTP upgrade is to protect water quality during thickener excursions. However, the available data do not suggest that wind protection measures, such as a dome cover for the thickener, are warranted.

The existing thickener underflow piping that emerges in the existing Pump Building will be re-used and the sludge pumps will be re-used, to the extent practical. It is expected that the existing sludge recycle pump purchased in 2006 to replace a failed pump (referred to as thickener Underflow Pump #2) is in good operating conditions and will be re-used. It is expected that the other existing sludge recycle pump (referred to as thickener Underflow Pump #1) will need to be replaced because it is worn out and inappropriately sized to cover the anticipated future range of required flow rates. The existing sludge wasting pump may be retained and re-used, although a second may be needed to provide backup and/or cover the required flow range.

1.4.2.4 Filters

The recent pilot study results indicate that effluent TSS will need to be approximately 1 mg/L or less to reliably achieve compliance with expected future discharge limits for metals and aquatic toxicity. This suggests that filters, although expensive, will likely be needed if/when the expected future discharge limits come into effect. See discussion of filters and the basis for this supposition in Attachment 1-B, from the August 12 teleconference between EPA, USACE, and CH2M HILL. CH2M HILL is not aware of any other technology that is cost-effective, technically feasible, and well-proven for enhancing solids removal following the lime treatment process. Even under the current, more lenient, discharge limits, filters will be needed for the CTP to be operated in HDS mode and to prevent periodic excursions that occur even in LDS mode. CH2M HILL's approved scope of work for this project includes design of the filter system, although the timing of filter construction has not been determined by EPA. Should USEPA decide to defer the design and installation of filters, this decision and necessary adjustments to the design will be documented in subsequent design reports.

Preliminary filter design assumes that deep-bed, mono-media (sand), gravity filters will be used. This selection is based on a experience with this type of filter providing effective performance at other HDS systems and because of the ease of O&M. For the purposes of developing an engineer's cost estimate for this Design Definition phase, it is assumed that the filters will be constructed as concrete vessels with vendor-supplied internals because of lower cost. The filters are preliminarily sized as four cells with dimensions of approximately 20-ft wide by 30-ft long, with 600 square feet (ft^2) per cell and a total surface area of about

2,400 ft^2. This equates to surface loading rates of approximately 3.75 gallons per minute per square foot (gpm/ft^2) at maximum flow and all four cells in operation, or about 4.75 gpm/ft^2 at maximum flow with one cell in backwash mode. The loading rates are much lower under base flow conditions, potentially allowing shutdown of one or two filter cells.

Ancillary features associated with filters include a filter feed (FF) sump and FF pumps (because there is insufficient head for gravity flow from the thickener to the top of filters), a clearwell and backwash supply (BWS) pumps, a dirty backwash (DBW) sump and DBW return pumps for re-circulating spent backwash fluid to Reactor B, an air scour blower to help clean filters during backwashing, piping, and instrumentation and controls. The ancillary vessels will be below-grade concrete sumps (see the tables included in Attachment 1-A for preliminary sizing) located beneath the Filter Building, and the FF sump and DBW sumps will require mixers to prevent solids from settling. A Filter Building will be constructed to house the filters and effluent system equipment.

1.4.2.5 Effluent System/Outfall

Currently, the CTP discharges effluent, via gravity flow, to Bunker Creek. This is unsatisfactory for the future because Bunker Creek loses water to the subsurface; therefore, continued use of this outfall would contribute more flow under the CIA and more volume extracted by the new CIA Groundwater Collection System requiring treatment at the CTP. Consequently, the current CTP upgrades design will include design of a system to convey CTP effluent to a new outfall to the SCFDR. The new outfall location is expected to be at the existing rip-rapped swale near the northeast corner of the CIA, constructed in the late 1990s to convey storm water from the CIA to the SFCDR. This new outfall location will require regulatory approval similar to the substantive requirements of NPDES waste discharge permitting.

In addition, Title 44 of the Code of Federal Regulations, Section 60.3 (d) (3), describes the National Flood Insurance Program's (NFIP) floodplain management criterion that prohibits floodway encroachments, new construction, substantial improvements, and other development unless it can be demonstrated that the proposed encroachment would not result in any increase in flood levels during base flood discharge. This NFIP criterion is adopted by participating communities using local ordinances, and in the case of this proposed new outfall location, Title 13, Chapter 1: Flood Hazard Prevention Regulations of the Kellogg City Code enforces this NFIP criterion, which requires submittal of a floodway "no-rise/no-impact" certification from a registered professional engineer documenting that the project will not impact the base flood elevations. CH2M HILL has conducted a cursory evaluation of the outfall's flow with respect to this no-rise/no-impact criterion that indicated that discharging effluent at the proposed new outfall location would result in an essentially negligible increase in river flow during high flow periods. For example, considering the Phase 1 CTP flow plus all of the potential OU 3 streams proposed for Phase 2, the CTP effluent is estimated to be only 0.36 percent of the 100-year SFCRD flow at the Kellogg gage. CH2M HILL has recommended to USEPA that contact occur with the City of Kellogg to determine the extent of technical documentation that will be necessary to meet the requirements of Title 13 of their city code.

There is insufficient elevation change to discharge effluent from the CTP to the SFCDR location by gravity flow; therefore, pumping will be required. A new set of effluent discharge pumps, which will draw flow from the clearwell, and a new effluent discharge pipeline will be designed. The pipeline routing is expected to run along the toe of the east side of the CIA and will ideally be co-located with the utility corridor bringing extracted groundwater to the CTP. The practicality and cost-effectiveness of oversizing the effluent discharge pipeline to accommodate potential future (Phase 2) CTP flows will be evaluated.

The recent pilot study indicated that relatively high treatment pH levels (e.g. pH 10.2 for HDS or pH 10.7 for LDS operation) may be required to meet future discharge limits for certain metals/elements. As a consequence of this, slight downward pH adjustment using acid and associated instrumentation and controls may be required to meet the future pH range required for discharge (pH 6.5 to 9.0).

1.4.2.6 Chemical Feed Systems

New chemical feed systems associated with the CTP upgrades include polymer, sulfide, and acid. A modern, automated polymer makeup and feed system will be provided to replace the existing manual system. This will be a packaged unit made by a reputable, widely-used vendor. Polymer flocculant solution, such as the Z-Floc 571 product (Zeroday Enterprises) currently used at the CTP, will be injected into the Reactor B effluent line. The existing system is located in a marginally adequate portion of the Pump Building. The tanks and pumps are tightly positioned in the space available, with little room for access and maintenance, and the dry polymer is received in 50-lb bags that are stacked against the wall and under the stairway. It is anticipated that the new polymer system will housed in a new building along with the sulfide system and the Reactor B aeration blowers, to provide more room and better access and unloading equipment for dry polymer delivery (e.g. super sacks).

The acid feed system may be needed for effluent pH adjustment to meet the future allowed discharge range. The need for acid addition will depend on the treatment pH employed at the CTP in the future, and whether the permitted discharge pH range is modified[5]; however, for now it is assumed that an effluent pH adjustment system is assumed in the design. Preliminarily, this system is expected to use vendor-supplied totes of hydrochloric acid (HCl) small feed pumps to inject concentrated acid into the discharge pipeline, a static mixer to effect rapid mixing, an in-line pH element to monitor pH downstream of the static mixer, and instrumentation and controls. HCl was selected over sulfuric acid despite having a higher cost and more handling issues to avoid potential gypsum precipitation and scaling in the effluent pipeline during high strength periods when excess sulfate is present in the CTP influent water.

A sulfide addition system will be designed because the pilot study indicated that sulfide addition may be required to meet expected discharge limits for thallium, especially during high-strength influent periods. This system will likely consist of a storage hopper for powdered sodium hydrosulfide (NaHS), a dry feed system, sulfide solution make-up/feed tank, and sulfide solution feed pumps. NaHS was chosen over sodium sulfide (Na_2S) because the latter is so basic that it increases solution pH and interferes with the HDS process, at higher doses.

[5] The Hecla Lucky Friday Mine in Mullan, ID requested and obtained a modification of their NPDES waste discharge permit to change the upper limit for pH from 9.0 to 10.0. The rationale given was that a treatment pH of 10.0 was required to meet discharge limits for metals.

There are two potential application points for sulfide addition (shown on the Preliminary PFD in the Drawings section of this TM). Pilot testing indicated that addition of sulfide between the two Reactor B tanks, in series, resulted in efficient removal of dissolved thallium, although fairly high sulfide doses were required for treatment of high-strength water. If filters are constructed, another possible sulfide introduction point is the filter feed sump. Although not tested in the pilot study, addition of sulfide after the solids/liquid separation process of a lime treatment system is an established polishing process (cf. EPA, 1980). The advantage of this location is that it would likely allow the use of smaller sulfide doses because sulfide addition before solids removal results in the re-solubilization of some metal hydroxide solids and re-precipitation as metal sulfides. Use of this location would require testing to demonstrate its effectiveness and would only be employed if it were shown to allow the use of low sulfide doses. If sulfide were added at the filter feed sump, polymer addition prior to the filters might be needed to increase the small particle size of sulfide solids for effective filtration.

1.4.2.7 Sludge Management

After the CTP upgrades are constructed, waste sludge will continue to be pumped to the sludge disposal cell on top of the CIA for disposal, commonly referred to as the sludge pond. This sludge pond will be used until it is full and then a new lined dewatering/disposal cell with an underdrain system will likely be constructed atop the CIA. Under current CTP operating conditions (treating only Bunker Hill Mine water and operating in LDS mode), the existing Sludge Pond is expected to reach capacity in approximately seven years. This projection is based on plotting the sludge level versus time using data collected from May 2000 through March 2013 and extrapolating the best-fit line to the indicated time at which only two feet of freeboard remain, the level considered full. The actual time until the existing sludge disposal cell reaches capacity will depend on a number of factors, including:

- Completion of CTP upgrades.
- Whether the CTP is operated in LDS or HDS mode.
- Collection and treatment of OU 2 groundwater (and eventually OU3 waters) at the CTP.
- Implementation of any source mitigation measures (principally the West Fork Milo Creek diversion) that would reduce the volume and strength of Bunker Hill AMD treated at the CTP and associated spikes in sludge production, such as the one that occurred in May 2011.

Analysis of pilot study sludge solids results indicates that operation of the CTP in LDS mode (for example, using a 6:1 to 12:1 solids recycle ratio [SRR] similar to current practice) treating Phase 1 influent water would generate an estimated 5 cubic yards of dewatered sludge per million gallons of water treated (yd^3/MG), whereas operation in full HDS mode would yield approximately one-third of that volume, or 1.6 yd^3/MG of dewatered sludge. This suggests that a given volume of sludge disposal cell capacity would last roughly three times longer under HDS operation.

1.4.3 Construction Approach

The proposed construction approach is to use temporary equipment to provide treatment of mine water during construction so that existing facilities can be demolished. The alternative to this approach is to construct new facilities while the existing system continues to operate. Advantages of the temporary treatment approach are that it:

- Avoids the need to construct retaining walls to allow construction without disrupting existing structures.
- Allows easier access for construction equipment.
- Most importantly, allows logical, proper positioning of new facilities, rather than having to place them in non-ideal spaces that are available and not currently occupied by existing equipment.

An important consideration for this approach is that construction should ideally be scheduled to avoid the late-Spring/early-Summer runoff period, so the temporary treatment system will not be in use during peak flow/strength conditions.

1.4.4 Selenium Treatment Challenge

During the base flow/strength conditions existing during the recent pilot study, selenium concentrations in Phase 1 influent water were less than the expected future discharge limits; therefore, they did not require treatment. However, the 1998-99 mine water data used to develop the high-strength influent water recipes for pilot testing indicate that selenium concentrations can be much higher than the future discharge limit values during high-strength periods.

Unfortunately, no information on selenium speciation exists for influent waters; consequently, sodium selenate (the Se[VI] form) was used to make up high-strength influent waters for conservative pilot testing[6]. It is possible that the selenium in mine water and groundwater is in the selenite (Se[IV]) form since both are somewhat reducing environments. While some modest selenium removal was observed during pilot testing, it was insufficient to meet the selenium discharge limit during high-strength testing. Experimentation with sulfide addition was ineffective for selenate removal.

Coincidentally, during CTP influent/effluent characterization conducted during the 2013 runoff period following the pilot study, CH2M HILL planned to analyze mine water samples for selenium speciation using an advanced technology (called dynamic reaction cell, or collision cell [CC]) in conjunction with the standard ICP/MS method (USEPA 200.8). Using this analytical method, none of the Kellogg Tunnel Portal samples contained measureable selenium (reporting limit = 0.2 µg/L), whereas analysis of the samples by ICP/MS without the CC technology yielded concentrations comparable to those measured during the pilot study (~1-7 µg/L). One of the reported advantages of the CC technology is that it eliminates analytical interferences which could be an issue for complex matrices like Bunker Hill Mine water. These pilot testing and analytical observations lead to a number of questions:

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[6] Selenium is normally found in natural waters in either the selenite (Se[IV]) or selenate (Se[VI]) form. Selenate tends to be more difficult to treat, at least by chemical precipitation/co-precipitation methods that are potentially most compatible with the CTP.

- If the form of selenium in CTP influent water is Se[IV], could it be effectively treated via co-precipitation with iron naturally present in mine water?
- Se[IV] reportedly requires a pH of 7 or less for effective co-precipitation, so could it be effectively removed in a polishing step after the HDS process?
- Is selenium actually present at elevated concentrations in mine water or is its detection in the past (in the pilot study and during the 1998-99 characterization effort) only an artifact of analytical interferences?

  Note: the USEPA Region 10 quality assurance group recently completed a review of the 1998-99 Bunker Hill Mine water characterization data set. The email from Don Metheney/USEPA on 8 August 2013 stated that they "could not find any anomalies within these data sets that would lead us to believe the elevated Selenium values to be false positives". But they expressed their support for the upcoming selenium investigation, saying "So, while we could find no technical reasons to discount the older data, questions on usability and comparability to current data remain. We still believe that confirmation sampling and analysis (via ICP-MS) of these potentially high sources would provide much needed information."

There are some fairly certain treatment methods of removing selenium from water, regardless of its form, including membrane separation (e.g. nanofiltration or reverse osmosis) and biological reduction to elemental selenium (Se^0). However, these methods can be quite expensive and/or not particularly well-suited for application at the Bunker Hill CTP where supplemental selenium removal may only be required during a portion of the year. Other selenium removal methods, such as iron co-precipitation, might be better suited as a supplemental treatment process at the CTP, although this process is simpler if the selenium is in the selenite form. Considering the lack of easy solutions for selenium treatment, some further investigation to address the questions posed above seems warranted.

A brief selenium investigation study is planned for early September 2013, to collect and analyze mine water samples that historically exhibited high Se levels using a variety of different analytical methods. The main objective of the study is to evaluate whether Site waters that will comprise the Phase 1 CTP influent contain elevated Se concentrations that require specialized Se treatment, using the best available analytical techniques for analyzing water samples.

1.5 Summary

A brief discussion of how each of the project objectives stated in the Introduction section will be addressed is provided below.

1. **Produce acceptable effluent quality**. Pilot testing demonstrated that effective treatment of most metals (those that precipitate as oxides/hydroxides) is fairly straightforward to achieve via the lime treatment process employed at the CTP, by using the proper treatment pH. However, there are potential issues associated with effective treatment of certain constituents/parameters to achieve compliance with expected future discharge limits. These challenging parameters and potential corrective measures are:

- Total zinc – Pilot test data indicate that post-clarification filters will be required to remove residual TSS and particulate zinc, to reliably meet the future total Zn discharge limits.

  Mitigative measures for modifying the Zn discharge limits do not seem likely (because site-specific water quality criteria have already been developed for the SFCDR and the SFCDR is already impaired for Zn), other than the possibility of a compliance schedule/interim limits, which would only postpone the imposition of the expected future limits.

- Thallium – Pilot test data indicate that the slightly elevated (compared to discharge limits) Tl concentrations occurring during base flow/strength conditions can be effectively treated using a high treatment pH of 10.7, or by using a lower treatment pH of 10.2 in conjunction with sulfide addition. The pilot study also indicated that operation at pH 10.7 impaired the ability to produce dense sludge, so this approach may not be compatible with HDS operation. Substantially elevated influent Tl concentrations that may occur during high flow/strength conditions would likely require sulfide addition for effective treatment, regardless of the operating mode or treatment pH used.

  Mitigative measures for modifying the future Tl discharge limits are possible and could be very beneficial for reducing Tl treatment costs. For example, a mixing zone allowance could reduce or even eliminate the need for specialized Tl treatment (e.g., sulfide addition or high treatment pH), depending on the dilution factors allowed. If variable mixing zone dilutions were allowed for a range of flow tiers, as in NPDES permits for other mines in the Silver Valley[7], a substantial dilution factor might be available for CTP discharge to the SFCDR during high-flow periods, when Tl concentrations may be appreciably elevated. In addition, a compliance schedule/interim limits for Tl could allow time for testing and evaluation of the need for, and optimum application of, the sulfide addition process.

- Selenium – The pilot study indicated that no specialized Se treatment would be needed during base flow/strength conditions, but that influent Se concentrations might be substantially higher than discharge limits during high flow/strength conditions and require specialized treatment. This supposition is based on old data, whose accuracy is uncertain. As mentioned in the Selenium Treatment Challenge section above, a Se investigation is planned to evaluate the existence of elevated Se concentrations that would necessitate specialized Se treatment at the CTP. If it is determined that Se treatment is necessary to meet the expected future discharge limits, further testing would be required to evaluate treatment methods and verify effectiveness.

  The possibility of mitigative measures for modifying the future Se discharge limits is similar to that described above for Tl: a mixing zone is possible and would be very beneficial, especially if flow tiers were allowed, since Se treatment would only be required during high flow/strength conditions that generally coincide with high

[7] Hecla Mining Company Lucky Friday Mine in Mullan, ID, and U.S. Silver Corp. Coeur and Galena Mines and Mills in Wallace, ID.

SFCDR flows. A mixing zone for Se could possibly eliminate the need for specialized Se treatment at the CTP. If Se treatment were needed, a compliance schedule/interim limits could allow time for testing and evaluation. In addition, a site specific variance for Se is possible and is currently being pursued in southeastern Idaho.

- WET – Pilot test data indicate that filtration would be needed to reliably meet a future discharge limit requiring no toxicity (i.e., $TU_c = 1.0$), under base flow/strength conditions. Furthermore, pilot testing results indicate that, even with filtration, the treated effluent might be toxic during high flow/strength conditions, possibly due to high TDS (only two bioassay tests were conducted and one sample was barely toxic).

  These results suggest that a mitigative measure would be greatly beneficial and might be required to reliably pass WET limits under all influent conditions. This could be achieved by a mixing zone or possibly by obtaining approval to use an alternate bioassay test species to the water flea, *Ceriodaphnia dubia*.

- pH – This is not a challenging parameter for treatment, but a variance to the permitted upper limit for discharge could reduce or eliminate (depending on the treatment pH employed) the need for effluent pH adjustment prior to discharge (acid addition for downward adjustment to met the expected future limit of 6.5-9.0). The Hecla Lucky Friday mine in Mullan, ID obtained such a permit modification, increasing the upper limit for pH from 9.0 to 10.0.

2. **Minimize sludge production**. The principal avenue for minimizing sludge volume production is operating the CTP in HDS mode rather than LDS mode. This would reduce the dewatered sludge volume produced by treating Phase 1 water by roughly three-fold. However, this is an operational decision, not a design issue. The upgrade design will allow operation in either LDS or HDS mode.

   A secondary means of reducing sludge production is to avoid operating at a particularly high treatment pH. A treatment pH of 10.7 causes substantial precipitation of magnesium as $Mg(OH)_2$, resulting in an appreciable increase in solids mass produced, as well as reduced sludge density (cited above in #1). This high treatment pH is used for treatment of Tl, and possibly Mn. Consequently, any mitigative measure that reduces or eliminates the need for treatment of Tl would also help reduce sludge production.

3. **Maximize system reliability**. Filters, if/when constructed, would enhance treatment performance reliability by providing removal of TSS/particulate metals that overflow from the thickener (e.g., provide backup polishing during thickener excursions). Other than filters, the main way of improving reliability is by providing redundancy, backup systems, spares, and monitors/alarms for key processes and equipment. Preliminary equipment redundancy is indicated in the equipment lists in Attachment 1-A. Further evaluation and selection of redundant and backup systems will be conducted in subsequent design phases.

4. **Incur acceptable capital and operating costs**. Operating the CTP in HDS mode would reduce overall water treatment costs by reducing the size/frequency and cost of constructing new sludge disposal facilities. As it was in 1974, the use of lime precipitation remains one the most cost-effective approaches for active treatment of

acidic and metals-containing mining-influenced water. In general, the pilot testing and design has and will continue to focus on cost-effective treatment methods, including specialized processes for Tl and Se and cost-reducing mitigative measures.

5. **Optimize operation by the commercial sector**. The CTP upgrade will be designed to support operation of the CTP by providers in the commercial sector. This will include the use of state-of-the-practice equipment, standardization of instrumentation and controls, accurate as-built drawings and labeling, updated operation and maintenance (O&M) procedures, documented software, and computer interfaces to instrumentation.

6. **Maximize sustainability**. The CTP upgrade will be designed for long-term sustainability, to the extent practical. Consideration of green materials and sustainable practices will begin in the next design phase.

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TM 1 Figures

Figure 1-1
Location Map – Bunker Hill Mining and Metallurgical Complex

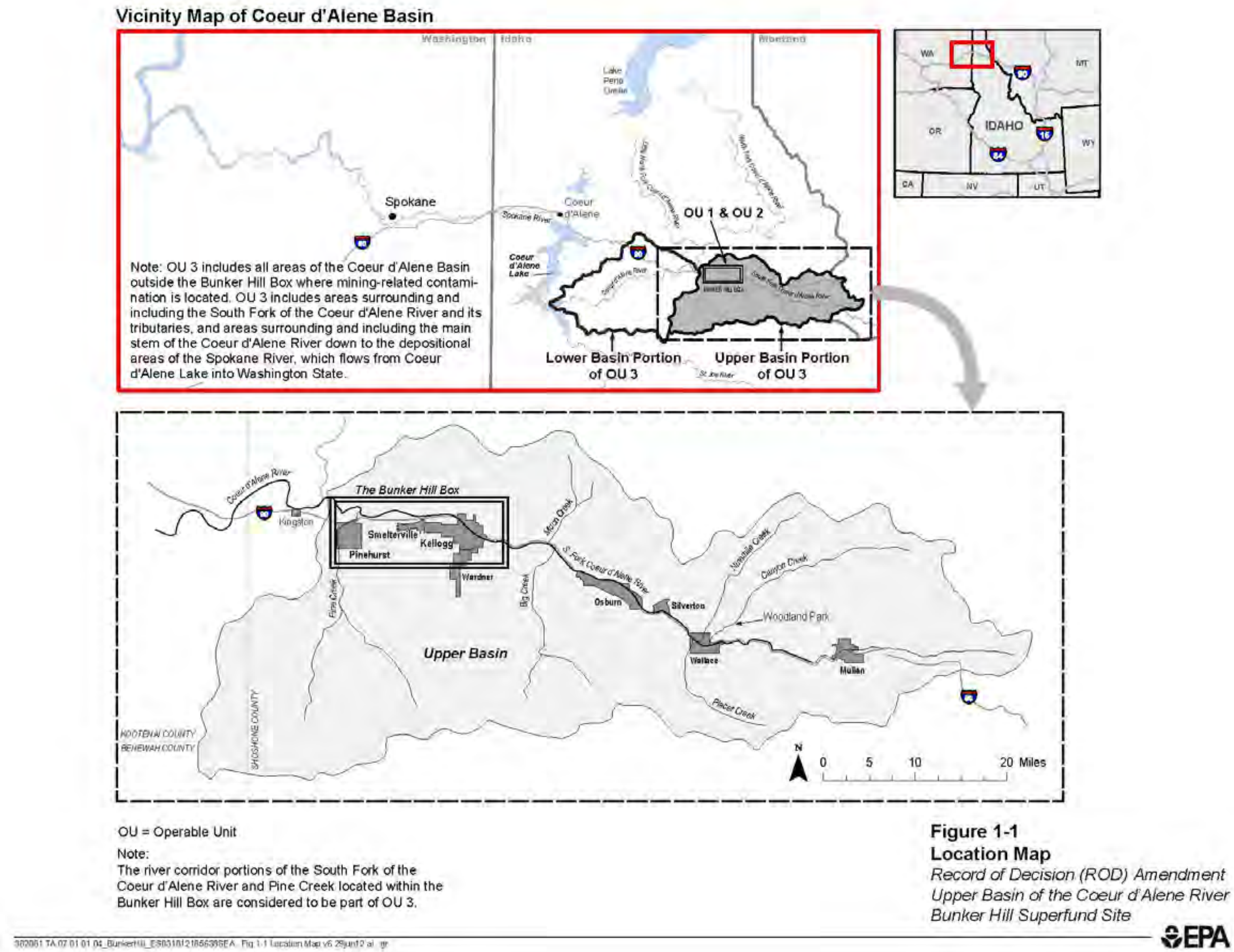
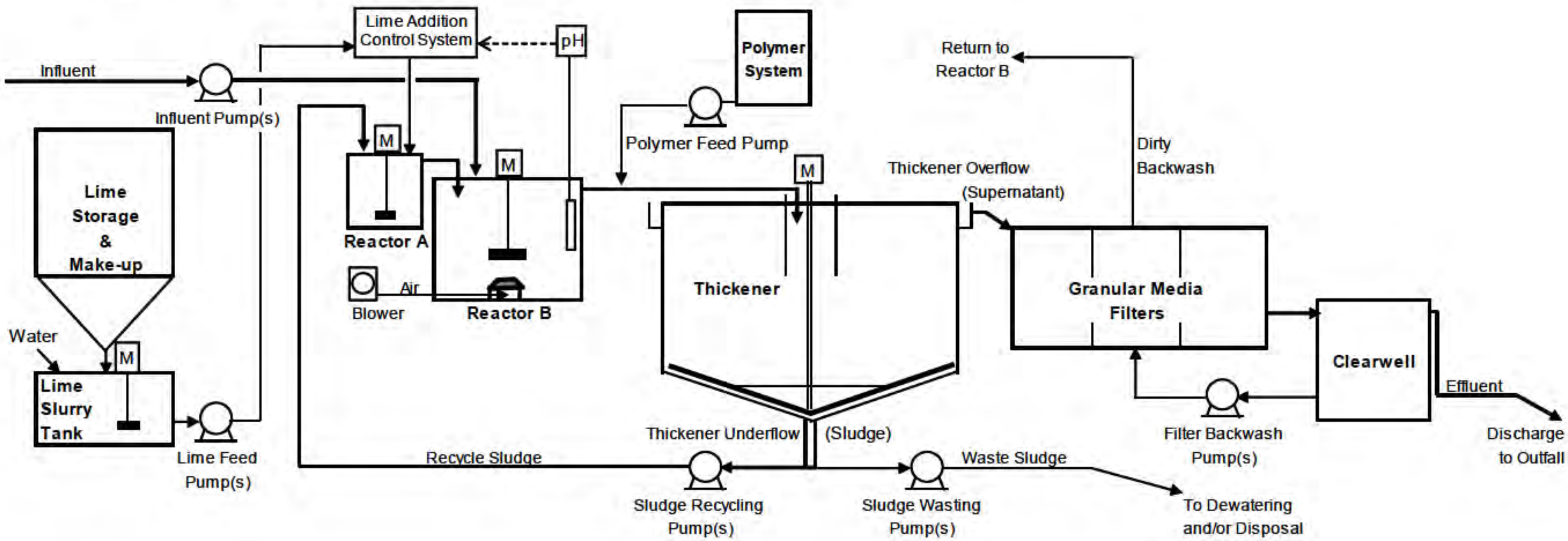


Figure 1-2
Basic HDS Process Flow Diagram



M = motor

Figure 1-3
Central Treatment Plant and Related Features

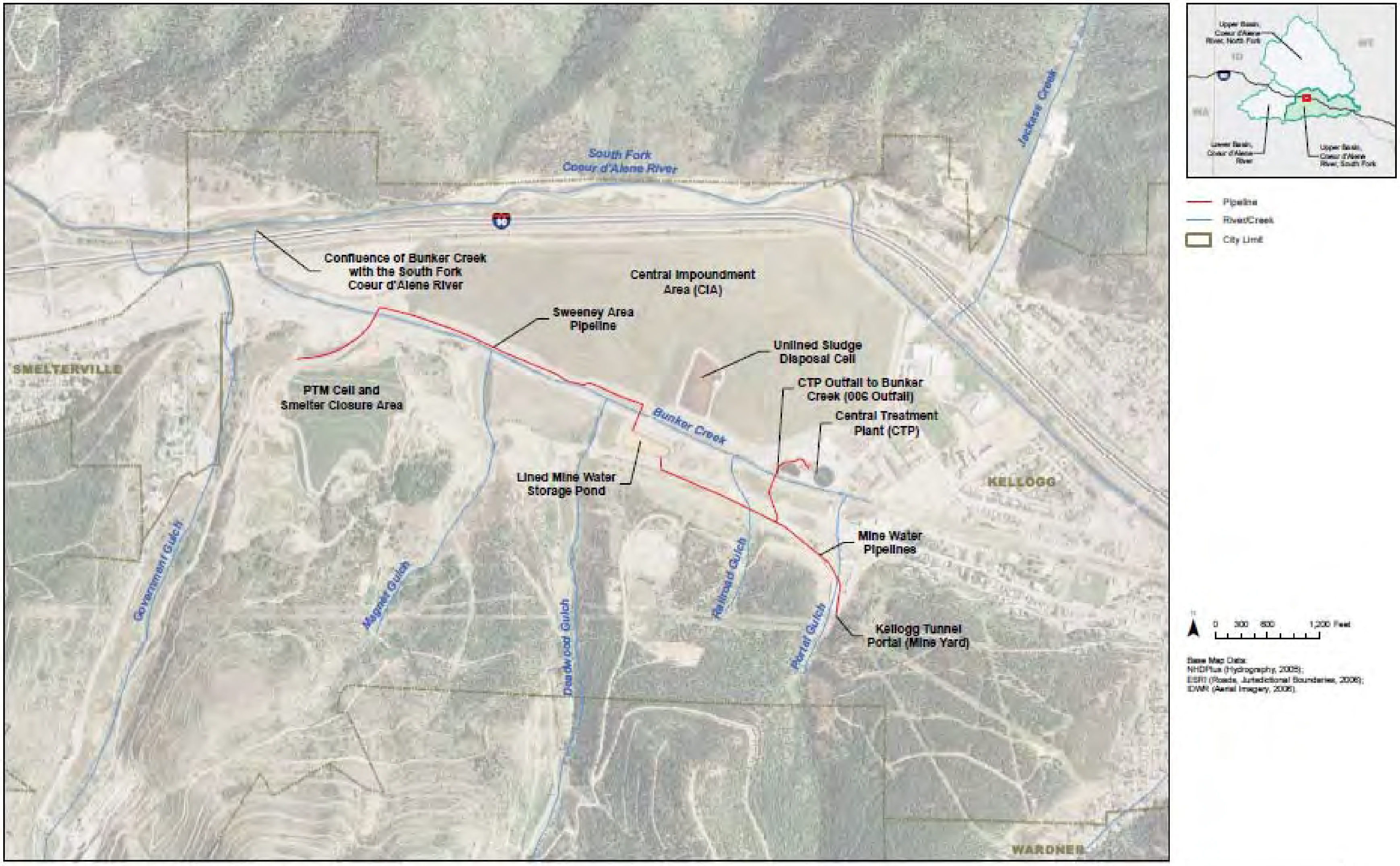
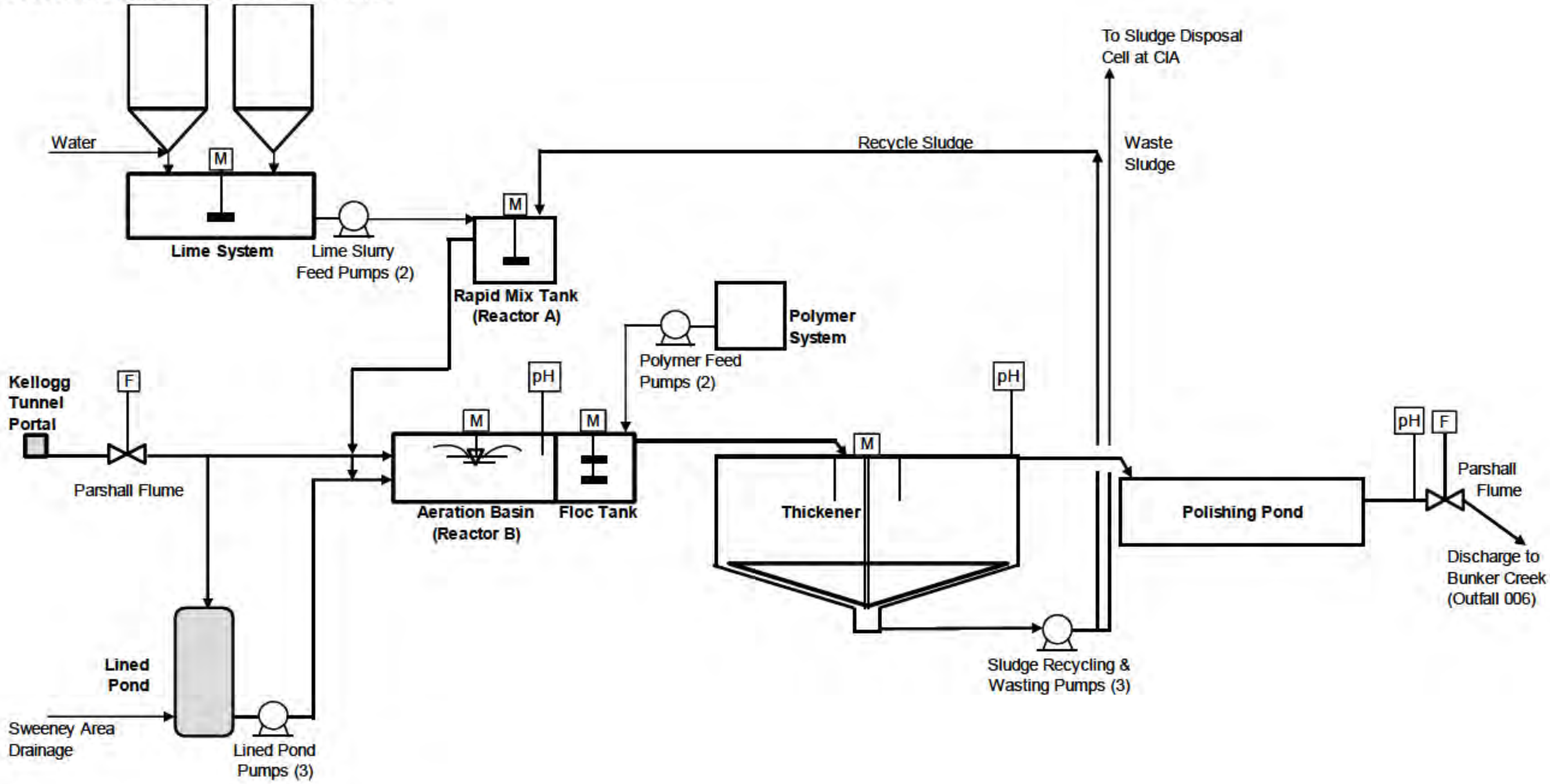


Figure 1-4
Current Bunker Hill CTP Flow Sheet

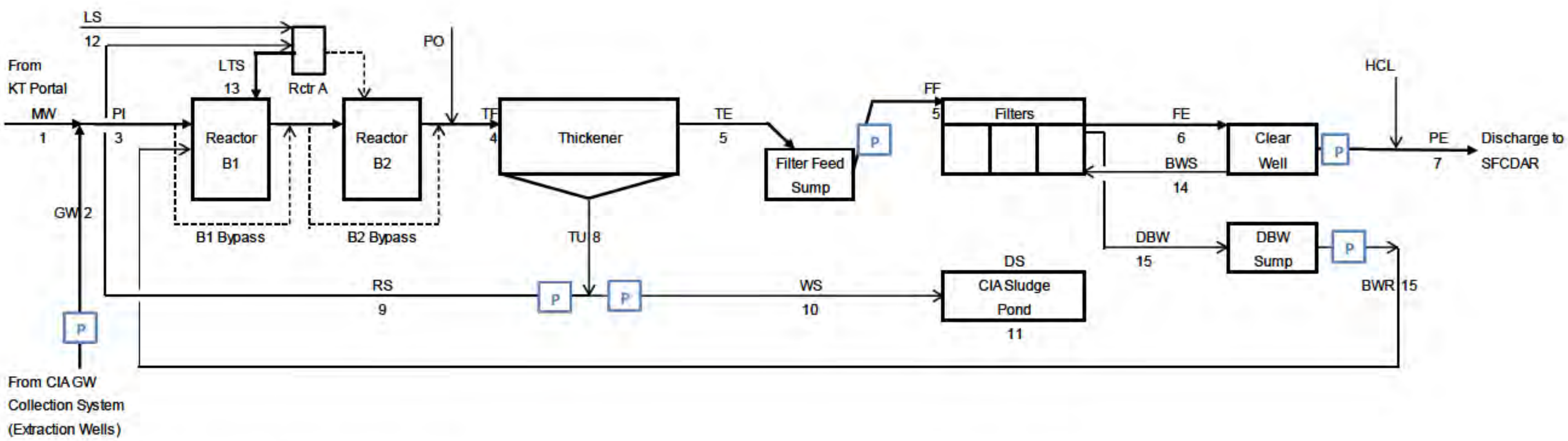


M = motor
F = flow measurement

Figure 1-5
Preliminary Flow and Solids Balance

Parameter	Units	1 Mine Water	2 CIA Ground Water	3 Plant Influent	4 Thickener Feed	5 Thickener Effluent/ Filter Feed	6 Filter Effluent	7 Plant Effluent	8 Thickener Underflow	9 Recycle Sludge	10 Waste Sludge*	11 Dewatered Sludge	12 Lime Slurry	13 Lime-Treated Sludge	14 Backwash Supply*	15 Dirty Backwash/ BW Return*
Max Flow Conditions																
Design flow, max	gpm	5,000	3,000	8,000	9,385	8,450	8,040	8,040	935	891	44		38.4	929	410	410
Solids concentration	mg/L	0	0	0	29,920	15	0	0	300,000	300,000	300,000		292,000	299,550	0	309
	SG	1.000	1.000	1.000	1.020	1.000	1.000	1.000	1.200	1.200	1.200		1.168	1.199	1.000	
	wt%	0	0	0	2.9	0.0015	0	0	25	25	25	40	25	25	0	
Solids mass rate	lb/min	0	0	0	2,341	1.06	0	0	2,340	2,229	111	111	94	2,322	0	1.06
Avg Flow Conditions																
Design flow, avg	gpm	1,300	2,000	3,300	3,537	3,485	3,316	3,316	52.2	49.7	2.5		6.4	56	169	169
Solids concentration	mg/L	0	0	0	4,433	15	0	0	300,000	300,000	300,000		106,100	276,950	0	309
	SG	1.000	1.000	1.000	1.003	1.000	1.000	1.000	1.200	1.200	1.200		1.061	1.184	1.000	
	wt%	0	0	0	0.4	0.0015	0	0	25	25	25	40	10	23.4	0	
Solids mass rate	lb/min	0	0	0	131	0.44	0	0	130	124	6.2	6.2	5.7	130	0	0.44

* average continuous rate
SG = specific gravity



Note: see Process Flow Diagram drawing for waste stream abbreviations.

TM 1 Preliminary Drawing

(b)(4) copyright

BUNKER HILL CTP UPGRADE / EXPANSION

PRELIMINARY
PROCESS FLOW DIAGRAM

CTP REMEDIAL DESIGN PROJECT
BUNKER HILL SUERFUND SITE
USEPA REGION 10
BUNKER HILL, SUPERFUND SITE, KELLOG ID

NO.	DATE	REVISION	BY	APVD

DSGN DR GH CHK DSP APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE
PROJ
DWG 100-G-060
SHEET of

PLOT TIME: 8:11:29 AM

Attachment 1-A
Preliminary Equipment Sizing

TABLE A-1
Preliminary Vessel Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Reactor A			***New, sizing based on target HRT***
No. of units	1		
Liquid volume	465	gal	
Diameter	4.3	ft	
Liquid height	4.3	ft	
Freeboard	3	ft	
Total sidewall height	7.3	ft	
HRT @ max influent flow	0.5	min	Normal target HRT = 1 to 5 min. Sizing is a compromise to accommodate wide range of design flows
HRT @ base influent flow	8.3	min	
Materials			Coated steel
Other			Vertical baffles, mixer
Reactor B			***New, sizing based on target HRT***
No. of units	2		In series
Liquid volume	140,300	gal	
Diameter	32	ft	
Liquid height	24	ft	
Freeboard	4	ft	
Total sidewall height	28	ft	
HRT @ max influent flow	30	min	Normal target HRT = 20 to 40 min.
HRT @ base influent flow	40	min	With 1 Reactor B in service, the other bypassed.
Materials			Coated steel
Other			Vertical baffles, mixer
Thickener			***Existing***
No. of units	1		
Diameter requirement	236	ft	
Liquid height	10	ft	Sidewall ht, not including cone bottom
HRT @ max influent flow	350	min	Not including cone bottom
HRT @ base influent flow	920	min	Not including cone bottom
Filter Feed Sump			***New, sizing based on target 7.5 min HRT at max flow***
No. of units	1		
Liquid volume	63,400	gal	
Side length	26.6	ft	Square assumed
Liquid height	12	ft	
Freeboard	2.5	ft	
Total sidewall height	14.5	ft	
HRT @ max influent flow	7.5	min	
HRT @ base influent flow	18	min	

TABLE A-1
Preliminary Vessel Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Materials			Concrete
Other			Mixer, below grade

TABLE A-1
Preliminary Vessel Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Granular Media (Sand) Filters			***New, sizing based on target HRT***
Filter type			Gravity, deep-bed, mono-media (sand)
Hydraulic loading, w/o BW	3.74	gpm/ft^2	At max flow
Hydraulic loading, w/1 BW	4.76	gpm/ft^2	At max flow, one filter in backwash mode.
Total surface area	2,360	ft^2	Required; round up of dimensions yields 2,400 ft^2
No. of units	4		
Surface area/filter	600	ft^2	
Filter width	20	ft	
Filter length	30	ft	Assumes 1:5:1 L/W ratio
Materials			Concrete vessels
Other			Internals provided by vendor
Clearwell			***New, sizing based on 2 BW volumes***
No. of units	1		
Liquid volume	147,700	gal	
Side length	40.6	ft	Square assumed
Liquid height	12	ft	
Freeboard	2.5	ft	
Total sidewall height	14.5	ft	
Materials			Concrete
Other			Below grade
Dirty Backwash Sump			***New, sizing based on 2.5 BW volumes***
No. of units	1		
Liquid volume	184,600	gal	
Side length	45.3	ft	Square assumed
Liquid height	12	ft	
Freeboard	2.5	ft	
Total sidewall height	14.5	ft	
Materials			Concrete
Other			Mixer, below grade
Polymer Make-up and Feed Tanks			***New, assume provided in polymer system package***
No. of units	1	ea	
Sulfide Make-up Tank [optional]			**New, sizing based on projected max dose of 50 mg/L**
No. of units	1		
Liquid volume	3,800	gal	
Side length	9	ft	
Liquid height	8	ft	
Freeboard	3	ft	

TABLE A-1
Preliminary Vessel Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Total sidewall height	11	ft	
HRT @ max influent flow	0.5	min	
HRT @ base influent flow	7.6	min	
Materials			Coated steel
Other			Vertical baffles, mixer
Hydrochloric Acid Tank (effluent neutralization)			***New, assume vendor-supplied totes***
No. of units	1	ea	

TABLE A-2
Preliminary Pump Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Filter Feed Pumps			*New*
No. of units	3		2 in service, 1 in-line spare
Pump type			Horizontal centrifugal
Drive type			VFD
Flow @ max influent flow	8,500	gpm	Daily averages. Should have additional capacity to account for water input from precipitation.
Flow @ base influent flow	3,500	gpm	
Pump capacity	4,400	gpm	
Total head	40	ft	
Power	60	HP	
Materials			
Backwash Supply Pumps			*New*
No. of units	3		2 potentially in service, 1 in-line spare at max influent flow
Pump type			Horizontal centrifugal
Drive type	VFD		
Flow during filter BW	7,500	gpm	1 filter backwashing, assumes 12.5 gpm/sf, 600 sf/filter
Flow during 2 filter BWs	7,500	gpm	For each of 2 pumps operating to backwash 2 filters simultaneously; same flow assumptions
Pump capacity		gpm	
Total head	40	ft	
Power	100	HP	
Materials			
Dirty Backwash Return Pumps			*New*
No. of units	3		2 in service, 1 in-line spare at max influent flow

TABLE A-2
Preliminary Pump Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Pump type			Horizontal centrifugal
Drive type			VFD
Flow @ max influent flow	600	gpm	Daily average ~415
Flow @ base influent flow	250	gpm	Daily average ~170
Pump capacity	610	gpm	
Total head	50	ft	
Power	10	HP	
Materials			
Polymer Feed Pumps			***New; assume provided in polymer system package***
No. of units	2		1 in service, 1 in-line spare
Pump type			Progressing cavity
Drive type			VFD
Flow @ max influent flow	28	gpm	
Flow @ base influent flow	11	gpm	
Total head	60	ft	Estimate based on similar project
Power	1	HP	
Materials			
Acid Pumps (Effluent Neutralization)			***New***
No. of units	2		1 in service, 1 in-line spare
Pump type			diaphragm or peristaltic
Drive type			VFD
Flow @ max influent flow	26	mL/min	Daily average
Flow @ base influent flow	11	mL/min	Daily average
Total head		ft	
Power	1	HP	High estimate for electrical loads
Materials			
Sulfide Solution Feed Pumps (optional)			***New***
No. of units	2		1 in service, 1 in-line spare
Pump type			diaphragm or peristaltic
Drive type			VFD
Flow @ max influent flow	2.4	gpm	estimate, should have wider range of flexibility
Flow @ base influent flow	1.4	gpm	estimate, should have wider range of flexibility
Total head		ft	
Power	1	HP	High estimate for electrical loads
Materials			
Sludge Recycle Pump #1			***New; size to cover lower end of sludge recycle flows***
No. of units	1		
Pump type			Horizontal centrifugal

TABLE A-2
Preliminary Pump Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Drive type			VFD
Flow @ base influent flow	50	gpm	Nominal for HDS operation, actual value will vary; suggest sizing for ~40-200 gpm
Pump capacity	200	gpm	
Total head	100	ft	assume approximately the same as Pump #2
Power	10	HP	
Materials			
Sludge Recycle Pump #2			***Existing, but relatively new***
No. of units	1		
Pump type			Centrifugal
Drive type			VFD
Flow range	200-900	gpm	Reported by Ferguson Contracting
Required flow at max flow	760	gpm	Nominal for HDS operation, actual value will vary
Total head		ft	estimated to be 100-150 ft based on the HP
Power	50	HP	
Materials			
Sludge Wasting Pump #1			***Existing***
No. of units	1		
Pump type			Centrifugal
Drive type			VFD
Flow @ base influent flow	15	gpm	Assumes wasting for 4 h/d (Est. continuous rate=2.5 gpm)
Total head		ft	
Power	30	HP	
Materials			
Sludge Wasting Pump #2			***New, assume two wasting pumps are needed to cover flow range***
No. of units	1		
Pump type			Centrifugal
Drive type			VFD
Flow @ max influent flow	230	gpm	Assumes wasting for 4 h/d (Est. continuous rate=38 gpm)
Pump capacity	250	gpm	
Total head		ft	could be up to 250 ft with a 30-hp motor,
Power	30	HP	based on existing pump
Materials			
Lime Slurry Feed Pumps			***Existing***
No. of units	2		
Pump type			

TABLE A-2
Preliminary Pump Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes

HP = horsepower
VFD = variable frequency drive

TABLE A-3
Preliminary Mixer and Blower Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
Reactor A Mixer			*New*
No. of units	1		
Power	2.5	HP	estimate - TBD by mixer vendor
Materials			SS shaft and impellor(s)
Other			Mounted vertically from bridge
Reactor B Mixer			*New*
No. of units	2		
Power	120	HP	estimate - TBD by mixer/aeration vendor
Materials			SS shaft and impellor(s)
Other			Mounted vertically from bridge
Filter Feed Sump Mixer			*New*
No. of units	1		
Power	32	HP	estimate - TBD by mixer vendor
Materials			SS shaft and impellor(s)
Other			Mounted vertically
Dirty Backwash Sump Mixer			*New*
No. of units	1		
Power	93	HP	estimate - TBD by mixer vendor
Materials			SS shaft and impellor(s)
Other			Mounted vertically
Polymer Make-Up Tank Mixer			***New; assume provided in polymer system package***
No. of units	1		
Sulfide Make-Up Tank Mixer [optional]			*New*
No. of units	1		
Power	10	HP	estimate - TBD by mixer vendor
Materials			SS shaft and impellor(s)
Other			Mounted vertically
Reactor B Aeration Blowers			*New*
No. of units	2		1 blower for each Reactor B tank, each with cross-connecting piping and capacity to service both reactors.
Blower type			
Air Flow @ max influent flow	1,042	scfm	estimate - TBD by mixer/aeration vendor
Power @ max influent flow	138	HP	estimate - TBD by mixer/aeration vendor
Air Flow @ base influent flow	216	scfm	estimate - TBD by mixer/aeration vendor
Power @ base influent flow	14	HP	estimate - TBD by mixer/aeration vendor
Other			
Filter Air Scour Blower			*New*

TABLE A-3
Preliminary Mixer and Blower Sizing Summary
Phase 1 CTP Upgrades

Item	Value	Units	Notes
No. of units	1		
Blower type			
Power		HP	
Air flow capacity	1,500	scfm	Based on 2.5 scfm/ft^2 and 600 ft^2/filter.

scfm = standard cubic feet per minute

Attachment 1-B
Supporting Information

Filters – Discussion

<u>Primary drivers</u>: TSS, total Zn, toxicity. Not TSS *per se*, but TSS in terms of its effect on total Zn and whole effluent toxicity (WET).

Note: this ignores Mn, Se, and Tl. In other words, it assumes that these elements are not an issue for effluent TSS and filters, because, for example: (a) actual future Mn limits are less stringent than previously projected; (b) dissolved Tl is effectively treated (e.g., by using high treatment pH and/or sulfide addition); (c) the planned Se investigation using improved analytical methods indicates that elevated Se concentrations requiring specialized treatment are not expected to occur in CTP influent; and/or (d) if necessary, dissolved Se is effectively treated using a specialized treatment method.

<u>Allowable TSS Level</u>: Roughly ≤1 mg/L, on a consistent basis. The backup/basis for this is discussed below.

TSS/Zn – For Phase 1 base flow/strength conditions, analysis of effluent total and dissolved Zn concentrations in relation to TSS indicates that effluent TSS would need to be in the range of approximately 1.6-2.5 mg/L for compliance. This is for <u>average</u> conditions – that is, average data were used in this analysis. Thus, to provide some margin of safety, it seems reasonable to assume that TSS must be ≤1.0 mg/L to reliably achieve compliance.

For Phase 1 high flow/strength conditions, pilot testing indicated that Zn could still be effectively treated, so the situation for total Zn/TSS would be expected to be roughly similar.

TSS/WET – Under base flow/strength conditions, unfiltered pilot plant effluent was found to cause toxicity to the water flea, *Ceriodaphnia dubia*, whereas filtered samples were normally non-toxic. A TSS/toxicity study conducted using Phase 1 base flow/strength effluent indicated that an effluent TSS level of ~1-2 mg/L would be required for effluent to be non-toxic. So, again, it seems reasonable to assume that a TSS of ≤1 mg/L would be required to reliably meet WET limits.

For Phase 1 high flow/strength conditions, it is unclear whether WET requirements could be met, and the observed toxicity may be due to TDS/conductivity.

<u>Conclusion</u>: Filters would be needed to consistently achieve the target effluent TSS level, and compliance with expected future discharge limits – regardless of how the CTP is operated (LDS or HDS mode, treatment pH, etc.). For example, effluent TSS data for the CTP operating in LDS mode over the past 6 months show that effluent TSS is frequently >1 mg/L without filters (see table below).

This conclusion is contingent upon to the premise that compliance with the expected future discharge limits is required, without modification. Some of the possible "mitigative measures" (e.g., variances or waivers, mixing zone, compliance schedule) may modify the effluent quality requirements and therefore affect this conclusion about the need for filters (see table describing mitigative measures and their effects).

Effluent TSS Data for the Bunker Hill CTP (from DMRs)

Date	Avg TSS [mg/L]	Max TSS [mg/L]	Monitoring Days with TSS >1.0 mg/L
Jan 2013	1.1	1.6	7 out of 13
Feb 2013	0.9	1.6	1 out of 12
Mar 2013	0.9	1.6	4 out of 13
Apr 2013	1.1	2.2	4 out of 13
May 2013	1.3	2.4	8 out of 14
Jun 2013	1.3	3.0	7 out of 12

Rationale	Likelihood	Effects
Assumed default condition in absence of the "mitigative measures" described below (#2-4)	Assumed to be in effect	Pilot study results suggest the following are needed for consistent compliance: - lime addition to produce a treatment pH in the 10.2-10.7 range - filters for polishing of TSS, particulate metals (e.g., Zn), and WET - sulfide addition for Tl removal under certain conditions - specialized Se treatment during high-strength conditions WET compliance under high-strength conditions is uncertain (toxicity possibly due to TDS/conductivity). **NOTE: Se may or may not be an issue, and is currently under investigation.**
National WQC for Tl are based on human health and the consumption of water or water+organisms. There are no WQC for Tl for the protection of aquatic life.	Possible	Would reduce or eliminate the need for sulfide addition (depending on whether Tl limits were raised or omitted). May allow use of a lower treatment pH (thereby reducing lime usage and sludge production).
WQC for Se are based on the protection of warm-water fishes, and are over-protective for the coldwater aquatic community in the SFCDR. Considerable work has gone into developing less stringent, site-specific WQC for Se in the phosphate mining region of southeastern Idaho that might also be applicable to the SFCDR.	Possible	Would reduce or eliminate the need for a specialized Se treatment process (depending on whether Se limits were raised or omitted). **See note above about Se (#1).**
None. Site-specific WQC for Zn have already been derived for the SFCDR.	Unlikely	The available data indicate that achieving consistent compliance with the expected future discharge limit for total Zn will require filters. **Thus, this category of mitigative measures (#2), if implemented, is not expected to eliminate the need for filters.**
Toxicity observed during the pilot study was confined to testing with *Ceriodaphnia dubia* (water flea). While a standard bioassay test method is available for this organism and it is commonly used as an indicator species, it is a planktonic cladoceran found in freshwater ponds, lakes, and marshes, but is not expected to be part of the aquatic community of the SFCDR. Alternative test species, such as rainbow trout or *Hyalella azteca*, (a benthic amphipod, or scud) might be more representative for the receiving water.	Possible	May reduce the need for filters for toxicity control (but not for Zn), depending on the sensitivity of alternate bioassay test species. May reduce or eliminate effluent toxicity challenges associated with high-strength water, especially if that toxicity is due to TDS/conductivity (to which *C. dubia* is known to be particularly sensitive).
USEPA policy and most States allow mixing zones in certain situations (e.g., where the receiving water provides adequate dilution of the effluent).	Possible	Would reduce or eliminate the need for some treatment elements. This could affect any or all of the treatment elements listed above for #1, depending on the dilution factors obtained, **but probably not the need for filters**, (no MZ allowance was allowed for Zn, Cd, or Pb in the Hecla or U.S. Silver permits, because the SFCDR is impaired for those elements). Could also eliminate the effluent toxicity challenge associated with high-strength water. Might require an effluent diffuser rather than discharging to the rip-rapped swale as currently proposed, but this doesn't appear to have been required in the Hecla or U.S. Silver permits.
Existing water quality in the SFCDR in the "box" limits attainment of certain beneficial uses. Remedial actions planned by the USEPA for upstream areas will lead to improved SFCDR water quality over time, as they are implemented. Consequently, less stringent discharge limits may be allowable for some period of time until other actions allow	Possible	Would reduce or eliminate the need for some treatment elements for some period of time until the expected future limits take effect. This could affect any or all of the treatment elements listed above for #1, **including the need for filters**, but would depend on which parameters are affected and to what degree limits are relaxed. Would allow time for full-scale testing to evaluate/optimize sulfide addition for Tl treatment (e.g., dose, point of application), and could also allow testing of Se treatment

Rationale	Likelihood	Effects
improvement of water quality.		methods, if needed (**see note above in #1**).

2 Civil Site Development Design Basis

Phase 1 CTP Upgrades – Project Design Definition

PREPARED FOR:	Ed Moreen/USEPA
PREPARED BY:	Matt Baldwin/CH2M HILL
REVIEWED BY:	Dan Peterson/CH2M HILL
DATE:	August 28, 2013

2.1 Introduction

The purpose of this technical memorandum is to document the existing features at the Bunker Hill Central Treatment Plant (CTP) within the Bunker Hill Superfund Site (Site) along with the proposed site civil design basis. Items addressed in this technical memorandum include the basis for layout such as major site features and site access.

2.2 Applicable Codes, Standards, and Design Criteria

2.2.1 Storm Water Design

- State of Idaho Best Management Practices for Storm Water and Erosion Control

2.2.2 Site Civil Design

- Shoshone County Site Disturbance Code
- Shoshone County Highway and Street Guidelines for Design and Construction
- American Association of State Highway and Transportation Officials (AASHTO) Policy on the Geometric Design of Highways and Streets (latest edition).

2.3 Site Location and Project Datum

The Project Site is 6.3 acres, located on the south side of Interstate Highway 90, in the city of Kellogg, Idaho.

A common horizontal and vertical datum will be used to tie multiple projects.

- Horizontal Datum: North American Datum (NAD) 1983.
- Vertical Datum: North American Vertical Datum (NAVD) 88.
- Grid System: Idaho State Plane Coordinate System, West Projection
- Units: United States Survey Feet
- Elevation Factor: Grid distance = to be determined by future site survey

2.4 Demolition and Relocation

The site development plan requires demolition or relocation of existing site facilities to support construction of the proposed site features. Facilities to be demolished include:

- Rapid mix tank
- Aeration basin
- Flocculation tank
- Polishing Pond
- Maintenance Building (relocation)
- Sludge recycle piping
- Lime slurry feed piping

It is understood that taking the CTP offline during construction requires mitigation of the current mine water flow stream. Due to the anticipated length of construction the required temporary storage volume for mine water would be large and impractical. The contractor will likely set up a temporary treatment plant, based on semi-trailer units to maintain treatment capacity for the duration of construction. A detailed phasing plan will be developed to control construction and demolition activities to ensure CTP operations.

The Aeration Basin, Flocculation Tank and Polishing Pond have accumulated deposits of sludge. This sludge will be removed from each facility prior to demolition and placed in the sludge pond on top of the CIA.

2.4.1 Site Access and Layout

Access to the Site will be from an existing driveway off of Wildcat Way. The access road enters the plant site from the northeast corner of the property, see drawing C-2.

In accordance with proposed design criteria, truck access through the plant will be sized to accommodate a WB-40 design vehicle. A WB-40 design vehicle is a semi-truck with a 33 foot trailer and an overall wheelbase of 40 feet. All on-site access roads will be gravel surfaced.

The proposed facilities will be constructed on the west portion of site, see drawing C-2. Reactor A and two Reactor B facilities are located adjacent to the west side of the existing thickener and aligned with the access bridge. The Blower/Polymer/Sulfide Building is located between the reactors and the existing thickener, aligned with the existing Pump House and Control Building. The Filter Building is located over the east end of the existing Polishing Pond and access is on the north side of the building. Access points to new facilities will have concrete stoops and aprons for egress as appropriate.

The CTP effluent pipeline has a primary and alternate alignment under evaluation. The primary alignment is along the eastern toe of the Central Impoundment Area (CIA), staying on USEPA and State right of way (ROW). The alternative alignment is along Wildcat Way and Bunker Avenue before transitioning onto USEPA and Sate ROW. See 2.7, Yard Piping for selection criteria. The primary and alternative alignments are shown on drawing C-1.

2.5 Grading and Drainage

The Site will be graded so storm water runoff will sheet flow to existing onsite ditches where it will be conveyed to Bunker Creek. The access roads will be designed to have longitudinal grades that will convey the runoff to the existing site drainage features. In locations where the runoff cannot be conveyed through longitudinal grades, catch basins and storm pipe will be constructed to convey the runoff to the preferred location. The site will be analyzed for storm water runoff regarding quality and rate of discharge. Storm water quality and quantity for the improvements will be designed in accordance with the City of Kellogg City Code Title 13: Flood Control.

Standard design practice is to provide finish elevation grades set 0.5-inch below doors to provide accessible entry through each of the facility access points. Grades will slope to approximately 0.5-feet below facility finish floor elevations away from the doors to prevent storm water from entering through the doors.

Criteria for slopes to be used for the site grading are:

- Access roads – 5 percent maximum grade, where accessibility needs to be maintained.
- Unpaved cut and fill slopes:
  - Fill slopes
  - Cut slopes
  - Drainage swales

2.6 Yard Piping

Existing piping requiring reconnection:

- Mine water pipeline direct feed branch
- Lined Pond influent pipeline
- Lime slurry feed loops
- Sludge recycle piping

Proposed pipelines on site:

- CIA groundwater influent pipeline
- CTP effluent pipeline (24-inch SDR 21 HDPE) Preliminary sizing of the CTP effluent pipeline is based on a combined 8,000 gpm design flow from Bunker Hill Mine and OU2 groundwater. During Schematic Design, the effluent pipe size will be evaluated and will consider additional potential OU3 flows.
- Filter feed pipeline (30-inch SDR 21 HDPE)
- Dirty backwash return pipeline (6-inch SDR 21 HDPE)

New pipelines on and off site will be routed in common corridors, where feasible. There are two alignment alternatives under evaluation approaching the CTP for the CIA Groundwater Influent Force Main and the CTP Effluent Pipeline. In order to minimize construction cost, it is anticipated that the CIA groundwater influent pipeline and CTP effluent pipeline will share a common alignment. The primary alignment is along the eastern toe of the CIA while the alternative alignment exits the CTP along Wildcat Way and turns north onto Bunker Avenue. However, property ownership, the ability to gain easements and required construction techniques may result in selection of the alternative alignment. Existing utilities on site include: potable water, natural gas, and sewer. Appropriate utility service connections will be made to each facility. Frost depth in Shoshone County is 24 inches. Minimum bury depth for pipelines will be 36 inches.

2.7 Outfall

At this phase, it is assumed that the CTP outfall will be constructed to discharge at the same location as the CIA surface water drainage outfall located at the northeast corner of the CIA. The existing CIA surface water drainage consists of a riprap lined ditch that outlets into the South Fork Coeur D'Alene River. However, this assumption may change based on whether a mixing zone outfall option is pursued for the effluent discharge. Should USEPA decide to apply for a mixing zone and it is granted by regulatory authorities, then the outfall design would likely include installation of a submerged pipe and potentially diffusers. It is assumed that this issue and the associated tradeoffs will be evaluated early in Schematic Design by USEPA and the CH2M HILL design team.

TM2 – Drawings

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CH2MHILL®

SITE DEVELOPMENT

OVERALL SITE PLAN

CTP REMEDIAL DESIGN PROJECT
BUNKER HILL SUERFUND SITE
USEPA REGION 10
BUNKER HILL, SUPERFUND SITE, KELLOG ID

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
M BALDWIN	S REDDELL		

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	2013/06/10
PROJ	382081
DWG	C-1
SHEET	of

PLOT TIME: 8:56:51 AM

(b)(4) copyright

NO.	DATE	REVISION	BY	APVD

DSGN M BALDWIN | DR S REDDELL | CHK | APVD

CTP REMEDIAL DESIGN PROJECT
BUNKER HILL SUERFUND SITE
USEPA REGION 10
BUNKER HILL, SUPERFUND SITE, KELLOG ID

CH2MHILL®

SITE DEVELOPMENT

LOCATION PLAN
AREA 1

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	2013/06/10
PROJ	382081
DWG	C-2
SHEET	of

PLOT TIME: 8:53:02 AM

3 Electrical Loads and Design Criteria

Phase 1 CTP Upgrades – Project Design Definition

PREPARED FOR:	Ed Moreen/USEPA
PREPARED BY:	Brian Pilmer/CH2M HILL
REVIEWED BY:	Morgan MacRostie/CH2M HILL
DATE:	August 28, 2013

3.1 Introduction

The purpose of this technical memorandum is to outline the electrical design process and set basic electrical design criteria for the Bunker Hill Central Treatment Plant (CTP) Remedial Design project.

This memorandum is organized as follows:

- Project Description
- Design Approach
- Codes, Regulations, Standards, and References
- Hazardous and Corrosive Area Definition
- Design Criteria
- Design Presentation

3.2 Project Description

The scope of the current project is to design facilities to:

- Improve CTP treatment performance to produce effluent water quality in accordance with future discharge limits; and
- Increase CTP capacity to accommodate water from a new Central Impoundment Area (CIA) Groundwater Collection System located in Operable Unit (OU) 2, in addition to the Bunker Hill Mine water that is currently treated.

3.3 Design Approach

3.3.1 Electrical Distribution and Standby Power Systems

Review of historical drawings and site investigation shows that the Bunker Hill CTP site is currently fed from a 500 kilovolt-ampere (kVA) AVISTA transformer adjacent to the Control Building. In addition, it shows that a 750 kilowatt (kW) generator was added by the Corp of Engineers to provide standby power backup for the entire site, sometime in 2005.

Due to the anticipated amount of additional load (according to electrical calculations) that will be added to the CTP as part of this project, the existing 750kW generator and existing electrical service will not be large enough to serve the entire facility, at the completion of construction. In order to maximize cost efficiency, and utilize the full capacity of the existing generator, a second standby generator will be added in lieu of redesigning the existing system to accommodate the entire plant.

For a preliminary load summary table showing estimate loads at the completion of construction, see Attachment 3-A. The table has been organized to show the additional loads at each proposed generator and electrical service.

The preliminary load estimate suggests that the new blower/chemical facility can be added to the existing electrical service and standby generator system, and still be under the 750kW rating of the existing generator. The existing automatic transfer switch was sized to accommodate a 750kW generator up to a 750kVA transformer. The transformer size, transfer switch size, and corresponding serve size were verified during a recent site investigation on July 31, 2013. Figure 3-1 is a picture of the existing transfer switch per USACE reviewer request:

FIGURE 3-1
Existing Transfer Switch

The preliminary load estimates suggest that the new Filter Building will require a new 750kW generator. The generator size will be refined during design as mechanical loads are further developed.

As mentioned above, this proposed configuration will result in two separate generators to serve the entire plant. This configuration will provide standby generator backup power for the entire demand load of plant, at the completion of construction. Further analysis will be performed during design to explore the possibility of running the plant at reduced capacity to reduce the size of the standby generator and increase cost savings.

3.4 Codes, Regulations, Standards, and References

The design will be based on the following codes and standards.

3.4.1 Codes

- 2011 National Electrical Code (NEC)
- 2009 Life Safety Code (NFPA-101-HB85)
- International Fire Code (IFC)
- 2007 National Electrical Safety Code (ANSI C2-2007)
- 2008 Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820)

3.4.2 Standards

- American National Standards Association (ANSI)
- National Electrical Testing Association (NETA)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Instrument Society of America (ISA)
- Insulated Cable Engineers Association (ICEA)
- Occupational Safety and Health Administration (OSHA)
- American Society for Testing Materials (ASTM)
- Underwriters Laboratory (UL)
- Illuminating Engineering Society (IES)
- National Fire Protection Association (NFPA)

3.5 Hazardous and Corrosive Area Definition

Corrosive, dry, wet, and high temperature locations will be called out on the drawings or described in the specifications. All materials and methods used will be rated for such areas.

3.6 Design Criteria

The basic goals of the design criteria are to:

- Develop safe, reliable, and maintainable electrical systems.
- Promote a consistent and uniform design approach and standardize the types and quality level of equipment specified.
- Establish a uniform basis for specifications and drawings.
- Provide a means of incorporating client input on items of preference and experience.

3.6.1 Listed and Labeled Equipment

Electrical equipment, materials, or services to be provided will have an attached label, symbol, or other identifying mark of an organization that is concerned with product evaluation, compliance with appropriate standards, and performance of the equipment. Typically this is the UL’s Label or Listing. In situations where a UL Label or Listing cannot be provided for equipment because of a lack of UL standards, then testing will be performed by an organization that is acceptable to the authority having jurisdiction.

3.6.2 Calculations

Calculations will be prepared in accordance with the project instructions and will be reviewed by a senior engineer.

3.6.2.1 Distribution Voltage Selection

Standard distribution systems to be used are:

- 480 volts, ungrounded delta, 3-phase, 3-wire.
- 208Y/120 volts solidly grounded, 3-phase, 4-wire.

3.6.2.2 Utilization Voltages

The equipment utilization voltages listed in Table 3-1 will be used.

TABLE 3-1
Equipment Utilization Voltages

Item	Voltage
Convenience Outlets	120 volts, single-phase
Motor Control	120 volts, alternating current
Motors, less than 1/2 horsepower	115 volts, single-phase
Motors, 1/2 horsepower and larger	460 volts, three-phase

3.6.2.3 Branch Circuits

Connected load and NEC requirements will be used for sizing branch circuit breakers and conductors.

A minimum wire size of No. 12 American wire gauge (AWG) copper will be used for 600 volt (V) branch power circuits. No. 10 AWG will be used when voltage drop requires a larger conductor. The number of duplex convenience receptacles on any one branch circuit will be limited to five.

3.6.2.4 Panelboards

Branch circuits or feeders on the drawings will identify the panelboard and device protecting the individual circuit or feeder.

Each new panelboard will be equipped with a minimum of 20 percent spare breakers with spaces, bus work, and terminations to complete the standard size panelboard. Also, 20 percent spare capacity will be provided.

Panelboard schedules indicating circuit identification, protective device trip rating, number of poles, load in volt-amps by phase, rating of main lugs or main circuit breaker, neutral bus size, ground bus size, and integrated short circuit rating of the panelboard will be prepared.

3.6.2.5 Motor Control

Motor control diagrams will be provided as part of the electrical drawing set.

3.6.2.6 Distribution System Equipment

Distribution equipment criteria include 480-volt motor control centers (MCCs) with combination motor starters of the motor circuit protector (MCP) type rated for the available fault current. Starters larger than NEMA size 3 (50 horsepower [hp]) will be the solid-state, soft-start type. 480-volt and 208Y/120-volt power distribution and lighting panelboards will be provided with molded case; bolt-in-place and plug-in; respectively; and circuit breakers with integrated short-circuit rating suitable for the available fault current.

3.6.2.7 Raceway Systems

Separate duct banks and manhole networks will be used for the following systems:

- Low voltage (50 to 600 V)
- Communications (50 V and less), including fiber

Special consideration will be given to separation of raceways involving low-level process control signal wiring and power system wiring to minimize the possibility of interference.

General guidelines for raceway sizing, selection, and installation are:

- The following minimum sizes will be used:
  - 3/4-inch minimum diameter for exposed conduit and conduit interior to structures.
  - 1-inch minimum diameter for conduit embedded in masonry, encased in concrete, and underground
- Polyvinyl chloride (PVC) -coated rigid galvanized steel conduit will be used for the transition from underground direct burial and under slab PVC conduit and concrete encased (in floor slab) PVC and rigid galvanized steel conduit to exposed rigid galvanized steel conduit.
- PVC-coated rigid galvanized steel conduit and fittings that are resistant to direct sunlight and include an interior urethane coating will be used in exposed corrosive interior and exterior areas.
- PVC-coated rigid galvanized steel conduit will be used for underground direct burial low-voltage status/control (less than 100 volts) and analog signal circuits.
- PVC Schedule 40 conduit and fittings will be used for underground direct burial, concrete encased duct banks, and under slabs.
- Rigid galvanized steel conduit and fittings will be used when exposed or concealed in interior non-corrosive process and non-process areas, and in non-corrosive areas outdoors.
- Flexible, nonmetallic, liquid-tight conduit 4-inch or smaller in size will be used for connections to motors, transformers, etc., as required. Fittings will be PVC-coated in wet or corrosive areas.
- Underground conduit routes will be identified with warning tape above underground direct burial conduits.

- Spare raceways will be tagged with a nonferrous metal tag attached to the raceway with a nylon strap. Raceway tags, with approved tag number provided by the contractor, will identify the raceway origin and destination and will be located at each terminus, near the midpoint, and at minimum intervals of every 50 feet on exposed raceways (in ceiling spaces and surface-mounted).

3.6.2.8 Wire and Cable

Copper conductors will be used for all wiring. Type XHHW insulation will be used for all process and non-process wiring.

Minimum conductor size of No. 14 AWG will be used for individual 120-volt control circuits.

Conductors and control cables will be tagged with a permanent sleeve or nylon marker plate attached with a nylon strap. Conductor tags with approved tag number will be provided by the contractor and will be located at each termination and in accessible locations.

120-volt control circuits may be combined in control cables containing multiple No. 14 AWG stranded copper conductors and a common PVC outer jacket.

Adequate separation of power and instrumentation and control wiring will be provided to avoid signal interference. Long parallel runs will be avoided, and analog wiring will be installed in steel conduit.

All wiring rated below 600-volts will be tested via 1,000-volt meggar test as part of project commissioning.

3.6.3 Color Coding

Conductor insulation colors shall be as shown in Table 3-2.

TABLE 3-2
System Color Coding

System	Conductor	Color
All Systems	Ground	Green
208Y/120 Volts	Neutral	White
	Phase A	Black
	Phase B	Red
	Phase C	Blue
480Y/277 Volts	Neutral	White
	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow

TABLE 3-2
System Color Coding

System	Conductor	Color
24 Volts Direct Current Inside Cabinet	Positive	Red
	Negative	Purple
Twisted Shielded Pair	Positive	Red or White
	Negative	Black

3.6.4 Enclosures

NEMA 1 enclosures will be used for equipment in electrical rooms and finished areas. NEMA 1 gasketed enclosures will be used for electrical equipment in dry industrial locations.

NEMA 4 enclosures will be used for outside and in wet locations, and NEMA 4X enclosures will be used for corrosive locations.

3.6.4.1 Convenience Receptacles

General service duplex receptacles will not be spaced more than 50 feet apart in process areas. Receptacles will be surface-mounted on walls or columns.

Waterproof receptacles will be installed in damp areas or areas subject to washdown.

Outlet-mounted ground-fault circuit-interrupters will be provided where required by the NEC. Panelboard or feed-through type devices will not be used.

3.6.5 Distribution System Protection

Equipment will be selected with adequate momentary and interrupting capacity for the point in the system where it is used. Series rated criteria will not be used, except for self-contained equipment.

3.6.6 Motor Protection and Controllers

3.6.6.1 General

Each motor will be provided with a suitable controller and devices that will protect the equipment and perform the functions required.

MCC-type construction will be used where multiple controllers can be practically grouped at a single location. Stand alone starter or adjustable frequency drive (AFD) enclosures will be used for select applications where MCC type construction is not practical or results in excessive cost.

MCCs will include feeder circuit breakers, motor starters, and AFDs. Motor starters for motors through 50 hp will be the full voltage, non-reversing, combination type with magnetic-only circuit breaker. Motor starters for motors larger than 50 hp will be the solid-state, soft-start, reduced voltage, combination type with magnetic-only circuit breaker.

3.6.6.2 Overload Protection

All motors will be provided with overload protection in ungrounded phases. Controller-mounted relays will be provided with external manual reset.

3.6.7 AC Induction Motors

Enclosures for both horizontal and vertical motors will be totally enclosed, fan cooled (TEFC) severe duty for indoor and outdoor locations. In wet and/or corrosive locations, chemical industry severe-duty (CISD-TEFC) motors will be used. Submerged motors will be totally submersible, air- or oil- sealed. Bearings will be rated 100,000-hour Anti-Friction Bearings Manufacturers' Association (AFBMA) B-10 life.

Alternating current (AC) induction motors will be the premium efficiency type with the following:

- Constant speed motors will have a 1.15 service factor. Variable speed motors will have a 1.0 service factor.
- Motor frames will be cast iron.
- Bearings for horizontal and vertical motors will be grease-lubricated, with grease addition and relief fittings.
- Motor windings will be copper wire. Aluminum windings are not acceptable.
- Motors operated by AFDs will be specified inverter duty rated.

3.6.8 Equipment Grounding

A separate ground conductor, sized in accordance with NEC requirements, will be installed in raceways for power feeders and branch circuit raceways for motor control, lighting, and receptacle loads.

Shields of shielded instrumentation cables will be grounded to the ground bus at the power supply for the analog or low voltage discrete signal circuit. Shielded instrumentation cables will not be grounded at more than one point.

3.7 Design Presentation

3.7.1 Drawings

3.7.1.1 Legend Sheet

The standard CH2M HILL legend sheet of electrical symbols and abbreviations, as modified for the project, will be used on design drawings.

3.7.1.2 Site Plans

Site plans will use civil backgrounds and show facility and major equipment locations, duct banks, and manholes. Site plans will also show facility designs where the facility does not require a separate drawing.

3.7.1.3 Process and Facility Plans

Process and facility plans will show the location of, and connection to, equipment that requires raceways and/or conductors. Spare raceways for future equipment will also be shown, where appropriate. Separate process and facility plans will generally be prepared. Receptacles, lights, and heating, ventilation, and air conditioning (HVAC) will be shown on the facility plans. General locations for process equipment will be shown on the process plans. Raceway size, conductor quantities and sizes, and homerun designations will be shown for facility circuits (power, lighting, etc.) on the plans. Major raceway (conduit and cable trays) rights-of-way will also be shown on the plans, as appropriate. Duct Bank Schedules will be used for site circuit and raceway. Cable block diagrams will be used for interior circuit and raceway of major power, control, and signaling systems. Hazardous areas and other area classifications will be called out on process and facility plan drawings.

3.7.1.4 One-Line Diagrams

One-line diagrams will show the electrical distribution from the point of connection at existing equipment, all the way down through all new distribution equipment provided as part of this project. Information on one-line diagrams will include available short circuit, connected load at each major bus, bus ratings, feeder sizes, overcurrent device sizes and types, instrument transformers, and transformer ratios. Three-phase HVAC loads will be shown on the appropriate one-line diagram.

3.7.1.5 Motor Control Schematic Diagrams

Motor control schematic diagrams will be included in the electrical drawing set.

3.7.1.6 Schedules

Schedules will include a luminaire schedule; panelboard schedules; manhole and handhole schedules (if required) and duct bank schedules.

3.7.1.7 Details

Details will generally be selected from CH2M HILL standard details. Special details will be developed for this project, as required for clarity.

3.7.2 Specifications

SpecsInTact specifications will be used as the basis for the electrical design. These specifications will be revised for project-specific situations, as required. The electrical specifications describe specific construction materials and products, and provide direction that influences the design approach and required calculations.

Attachment 3-A
Preliminary Load Summary Table

EQUIPMENT	LOAD DESCRIPTION	KVA orHP	AMPS @ 480V	Qty Conn.	Qty Running	TOTAL CONNECTED LOAD, AMPS @ 480V		TOTAL DEMAND LOAD, AMPS @ 480V	
700MCC1001 (EXST)	B1 REACTOR MIXER	100.00	124.0	1	1	124		99.2	
(CONTROL BLDG)	B2 REACTOR MIXER	100.00	124.0	1	1	124		99.2	
	THICKENER RAKE DRIVES	7.50	11.0	2	2	22		17.6	
	SLUDGE RECYCLE PUMP #1	50.00	65.0	1	1	65		52	
	SLUDGE RECYCLE PUMP #2	10.00	14.0	1	0	14		0	
	SLUDGE WASTING PUMP #1	30.00	40.0	1	1	40		32	
	SLUDGE WASTING PUMP #2	30.00	40.0	1	0	40		0	
	A REACTOR MIXER	2.50	4.8	1	1	4.8		3.84	
	LIME SYSTEM	-	160.0	1	1	160		128	
	UNIT HEATERS (EXST)	5.00	7.6	2	2	15.2		12.16	
	EXHAUST FAN (EXST)	3.00	4.8	1	1	4.8		3.84	
	AIR SUPPLY UNIT	-	30.0	1	1	30		24	
	PANELBOARD 208Y/120V (EXST)	30.00	36.0	1	1	36		28.8	
	MAINTENANCE BLDG PANEL (EXST)	10.00	12.0	1	1	12		9.6	
	SAMPLE BLDG	4.00	5.0	1	1	5		4	
		700MCC1001 (EXST) LOAD SUBTOTAL				**696.8**	**Amps**	**514.24**	**Amps**
						579	**kVA**	**427**	**kVA**
NEW MCC	B1 REACTOR BLOWER	150.00	180.0	1	1	180		144	
(BLOWER BLDG)	B2 REACTOR BLOWER	150.00	180.0	1	0	180		0	
	SULFIDE MAKE-UP TANK MIXER	10.00	14.0	1	1	14		11.2	
	SULFIDE FEED PUMPS	1.00	3.0	2	1	6		2.4	
	ACID FEED PUMPS	1.00	3.0	2	1	6		2.4	
	POLYMER MAKEUP SYSTEM	5.00	7.6	1	1	7.6		6.08	
	POLYMER FEED PUMPS	1.00	2.1	2	1	4.2		1.68	
	PANELBOARD 480V	30.00	40.0	1	1	40		32	
	MISC HVAC	60.00	77.0	1	1	77		61.6	
		NEW BLOWER BLDG MCC LOAD SUBTOTAL				**514.8**	**Amps**	**261.36**	**Amps**
						427	**kVA**	**217**	**kVA**

EQUIPMENT	LOAD DESCRIPTION	KVA or HP	AMPS @ 480V	Qty Conn.	Qty Running	TOTAL CONNECTED LOAD, AMPS @ 480V		TOTAL DEMAND LOAD, AMPS @ 480V	
	TOTAL LOAD ON EXISTING TRANSFORMER AND GENERATOR					**1212**	**Amps**	**776**	**Amps**
	(EXISTING CONTROL BLDG MCC AND NEW BLOWER BLDG MCC)					**1006**	**kVA**	**644**	**kVA**
NEW MCC	FILTER FEED SUMP MIXER	50.00	65.0	1	1	65		52	
(FILTER BLDG)	DBW SUMP MIXER	100.00	124.0	1	1	124		99.2	
	FILTER FEED PUMPS	60.00	77.0	3	2	231		123.2	
	BACKWASH SUPPLY PUMPS	100.00	124.0	3	2	372		198.4	
	DBW RETURN PUMPS	10.00	14.0	3	2	42		22.4	
	EFFLUENT DISCHARGE PUMPS	75.00	96.0	3	2	288		153.6	
	FILTER AIR SCOUR BLOWER	200.00	240.0	1	1	240		192	
	PANELBOARD 208/120V	30.00	40.0	1	1	40		32	
	PANELBOARD 480V	30.00	40.0	1	1	40		32	
	MISC HVAC	60.00	77.0	1	1	77		61.6	
		NEW FILTER BLDG MCC LOAD SUBTOTAL				**1519**	**Amps**	**966.4**	**Amps**
						1261	**kVA**	**802**	**kVA**
			TOTAL PLANT LOAD			**2731**	**Amps**	**1742**	**Amps**
						2267	**kVA**	**1447**	**kVA**

4 Instrumentation and Control Concepts

Phase 1 CTP Upgrades – Project Design Definition

PREPARED FOR: Ed Moreen/USEPA

PREPARED BY: Kim Anderson/CH2M HILL

REVIEWED BY: Brian deGlanville/CH2M HILL

DATE: August 28, 2013

4.1 Introduction

This technical memorandum defines the anticipated upgrades to instrumentation and control hardware, software and networking associated with the Central Treatment Plant (CTP) process upgrades. Upgrades to instrumentation and control systems are expected to include additions to the existing control system and replacement of outdated components. Modifications to the existing standard and application specific control system software packages are expected, in order to maintain and improve the functionality and provide for the long term maintenance requirements of the treatment plant. Additional new processors and remote input/output (I/O) are anticipated to be needed, specifically for the addition of filters to the CTP and the addition of the flows from the new Central Impoundment Area (CIA) groundwater collection well field.

4.2 Existing System

The existing control system at the plant is based on the use of Siemens "S7" programmable logic controllers (PLCs) and Rockwell Automation RSView 32 human machine interface (HMI) software. Currently, the plant has two PLC controllers. Controller A is a Siemens S7 400, which controls and monitors the aeration basin, clarifier, sludge recirculation and waste pumps, and other peripheral equipment separate from the lime system. Controller B is a Siemens S7 300, supplied by the lime system package vendor, which controls lime slurry makeup and injection and other equipment located in the lime silos. Controller B has two remote drops, one in each silo, to pick up I/O signals. Controller B communicates to the remote I/O in the silos over a Profibus distributed peripheral (DP) serial network.

Both Controller A and Controller B are approaching the end of their expected life, which for computer control equipment of this type is approximately 10 years.

An Ethernet local area network (LAN) links Controller A and Controller B to each other and to the Rockwell HMI, which is located in the upstairs control room of the plant Control Building. The HMI consists of two workstations and a server. The server runs one copy of the Rockwell RSView 32 HMI software, the plant data collection "historian", and the Operations and Maintenance Manual. Workstation A runs a separately licensed copy of the Rockwell RSView 32 software. Workstation B is an "Active Display Client" to the server, and as such, is a viewing and control workstation for the software running on the server.

The server and workstations in use at the CTP were purchased in the first quarter of 2004. The serviceable life of personal compuer (PC) and server components is typically four or five years, so the CTP workstations and server are due for replacement. The HMI software used at the CTP, Rockwell RSView32, is no longer supported by the manufacturer and has been replaced on the market with newer products. Likewise, the server and workstation operating systems are not supported or soon to be unsupported by Microsoft. The existing server and workstations are recommended for replacement with new equipment, current standard operating systems (Windows 7 Professional and Microsoft Server 2008), and current HMI software package as part of this project.

Processors in both existing PLCs are past the manufacturer’s end of life cycle and are not compatible with current versions of the Siemens S7 programming software packages. Several other hardware components in the control system, including the communications modules, are also past their end of life cycle and are no longer supported by the manufacturer. The existing control processors for Controller A and Controller B cannot be addressed, programmed, or modified with current Siemens S7 v12 programming software, and conversely, the new processors and control components expected to be added to the CTP will require the use of current software versions. Therefore, both existing processors are expected to be replaced under this project. To do otherwise creates a “dual system” where portions of the plant operate on an old software package and other portions operate on a separate, incompatible software package. The result of a dual system creates higher maintenance costs, less functionality in the system, and a less robust control system, since much of the system would be outdated. This is not the case for all the control system components and many of the existing components will continue to be used, where viable.

The current control system uses Symatic’s “PC Anywhere” software for remote connection by operators. This software has been identified as highly vulnerable to hacking, and is no longer recommended for use on critical system applications. It is strongly advised that the PC Anywhere software be uninstalled and no longer used. Newer technologies, using virtual private networks and firewalls are available to provide secure access to the plant control system by select individuals.

4.3 Design Criteria

The primary considerations for instrumentation and control design upgrades to the CTP are:

- Safety - To provide a safe work environment for plant operators and the environment. Safety considerations include design of control components and systems that minimizes hazards during plant maintenance and operation procedures. The safe operation design criteria also extends to environmental protection. This includes design that provides operators with timely and accurate information for making process decisions, minimize waste of expendables, and allows the plant to run efficiently and within designed specifications.

- Redundancy - The control system will be designed to provide backup systems for operation of critical processes, to allow operators with alternate means of controlling the plant processes, and to allow for normal wear and loss of plant equipment without disruption of critical processes.

- Longevity - To provide a system that will operate as trouble free as possible for as long as possible.
- Cost Efficiency - The capital cost of a properly designed, well maintained control system will typically amount to less than ten percent of the overall construction budget for the project, but can return many times that cost in efficiency, saved labor, and the conservation of expendables.
- Ease of Use – Operator access and ease of use will be considered for all new hardware, instrumentation and control components, as well as software required for the facility.

4.4 Basis of Design

4.4.1 Plant Operations

Existing approaches for plant operations will be used as the basis for control and monitoring of additions to the plant. Plant operators will generally be provided with two separate methods of performing plant operations: manually, and through the plant control system (PCS). Local, manual operation will be provided, where feasible, through the use of local Hand/Off/Auto control of motors and valves, either at the MCC, or at local control stations.

Under normal operating conditions, the plant will be run utilizing the PCS. Manual, local control is provided as a backup to PCS control and to provide a level of redundancy. Manual control is useful for troubleshooting and testing purposes, but not all of the built-in software interlocking protections inherent to computer control of equipment will function when equipment is operated in Local/Manual mode. Hardwired, safety interlocks will be utilized to protect personnel, to allow safe manual control of equipment, for emergency stops, and to protect equipment, where necessary.

4.4.2 PCS Graphics

The existing PCS computer screens used to control the CTP will be converted and modified to reflect process changes as a result of plant upgrades and to provide for operation with the replacement HMI software. Existing screens will be utilized or will be modified to adjust to the changes in processes. Screens will make use of the interactive graphics inherent to the HMI software to allow point and click functionality for operator control.

4.4.3 PCS Security

The PCS will use the built in security features of the Microsoft Windows 7 and Microsoft Server 2008 operating systems, as well as the login/password protection functions of the HMI software. It will be configured to provide different operators, with different job functions at the facility, with separate access controls for what they can change or modify in the PCS system. The PC Anywhere software, currently being used to dial in to the plant, will be replaced with a more robust and secure virtual private network access point, utilizing adequate firewall protection to curtail unauthorized access to plant control.

4.4.4 Training

Training of plant operators will be included as part of the contracted work for the plant upgrades. Training will include hands –on and classroom training for operators in running, maintaining, and troubleshooting the control systems and instrumentation.

Under most circumstances, Information Technology (IT) support personnel, trained in computer technology, will be needed to troubleshoot and maintain computers and the network infrastructure in working condition. However, PLCs require specific knowledge and training that may only be available from the Spokane area. Training on the control system will include information on how plant operators can and should make decisions about the use of IT support, and when other professionals, with more specific training in PLC programming and network configuration should be utilized.

4.5 Construction Constraints

Many of the existing PLC components, workstations, and servers at the plant will require replacement. This will require close coordination between plant operations, software developers, and the general contractor responsible for work at the site, in order to maintain the plant running while new hardware is installed. Requirements for replacement of existing equipment will be outlined in detail in the design specifications. In addition, frequent, comprehensive schedule planning and schedule updates will be required of all parties, including the general contractor, systems integrator, programmer, electrician, and plant operators. A protocol defining the procedures for completion of the replacement of components will be the responsibility of the general contractor, with required approval from the Engineer and other responsible parties.

The existing Ethernet communications will be utilized and expanded though out the plant to link PLC control components, and for communications between the PLCs and the HMI operator workstations. Most of the communications network within the plant will be adequately served by new network switches and copper Ethernet cabling. A fiber optic LAN will be designed for control communications to the CIA groundwater collection well field sites.

4.6 Design Development Issues

By their nature, control PLCs and their associated software packages are proprietary. Among the five major manufacturers for this type of equipment only sporadic and partial compatibility exists for communication between them, and usually only for networking and connection to so called “third party” devices, such as field instrument buses and MCCs. The essential software packages used to write application specific computer control code for these controllers is proprietary to each manufacturer. As a result, the selection and use of a single manufacturer for PLC equipment is a technological and economic necessity.

During the 2002 time critical removal action, which included the controls for the replacement lime silos, and during the subsequent control upgrades to the remainder of the existing plant, the USACE and CH2M HILL reviewed several PLC equipment providers. From this review, Siemens S7 controllers were chosen for the CTP. The continued sole sourcing of Siemens PLC equipment for the Bunker Hill CTP will provide continuity between the existing plant and new facilities and equipment. Even though a significant portion of the CTP’s PLC equipment will require upgrading or replacement, the continued use of the same manufacturer is recommended. To do so will prevent the need to replace all the PLCs at the plant and the associated high cost of reprogramming existing facilities.

The need to replace the existing RSView32 HMI software provides an opportunity for multiple manufacturers of similar software packages to bid for supplying the HMI software. However, it is recommended that the possible vendors be limited to either Siemens “Total Integration Automation” WinCC software, or Invensys Wonderware “InTouch”, or some equal. Both these software packages meet and/or exceed the requirements of the CTP system, and are industry standards for functionality, security and development. Either package will integrate seamlessly with the Siemens PLC controllers.

5 Project Implementation and Estimated Cost of Construction

Phase 1 CTP Upgrades – Project Design Definition

PREPARED FOR: Ed Moreen/USEPA Kim Prestbo/USEPA

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DATE: August 28, 2013

5.1 Introduction

This project delivery analysis discusses the delivery schedule and estimated construction costs for the Bunker Hill Central Treatment Plant (CTP) Upgrades at this project design definition phase.

5.2 Construction Sequencing and Constraints

Construction of improvements within and around existing tankage and facilities will require careful planning so that effluent limits and operational goals can be met throughout construction. Constructing the proposed facilities, in the midst of ongoing plant operation, will require a number of sequencing and construction constraints that will be incorporated into the construction schedule and bid documents as requirements for the contractor whose scope is anticipated to include construction of the plant upgrades and continued operation during that time, and likely beyond for a designated period of time.

5.2.1 Operational Constraints

As highlighted in *TM 1 – Process Mechanical Design Basis*, there is limited capacity to store influent flows in the Lined Pond. In addition, during the spring runoff period the influent flow and strength of the Bunker Hill mine water increases substantially compared with the remaining times of year. Therefore, the construction documents are recommended to include contract provisions that require the contractor to provide continuous treatment, likely through a combination of using available storage at the Lined Pond and by providing temporary treatment equipment, as needed when the plant is shut-down for upgrades. It is recommended that a performance-based approach be used such that conducting the construction and meeting the effluent discharge limits are the sole responsibilities of the contractor. In addition, if at all possible, it is recommended that the existing treatment plant operations be used during the high flow spring runoff period (versus a temporary treatment approach) because of the high flow volume and the associated high strength of the mine flow during this time.

The use of temporary equipment to provide treatment of mine water during construction is needed so that existing facilities can be demolished. Advantages of the temporary treatment approach include:

- Avoiding the need to construct retaining walls to allow construction without disrupting existing structures.
- Allowing for easier access for construction equipment.
- Allowing the new facilities to be optimally positioned rather than located in non-ideal spaces that are available and not currently occupied by existing equipment.

5.2.2 Procurement Constraints

It is important to identify procurement lead times for equipment when developing construction sequencing. At this time, CH2M HILL staff do not believe that the government will need to pre-purchase equipment in order to provide "owner-provided" equipment to the contractor. During schematic design, a review of equipment needs and lead time for procurement will be done to determine if any equipment should be procured early by the contractor to avoid construction delays.

5.3 Delivery Schedule

The preliminary schedule for design and construction is shown on Figure 5-1, located at the end of the technical memorandum. The design effort began with a Partnering workshop at USACE offices in Seattle on March 29, 2013. Anticipated completion dates for the various design phases are:

1. Project Design Definition - July 31, 2013.
2. 30 Percent Schematic Design - December 6, 2013. .
3. 60 Percent Design Development - March 7, 2014.
4. 90 Percent Complete Construction Documents - June 13, 2014.
5. 100 Percent Bid-Ready Documents – July 28, 2014

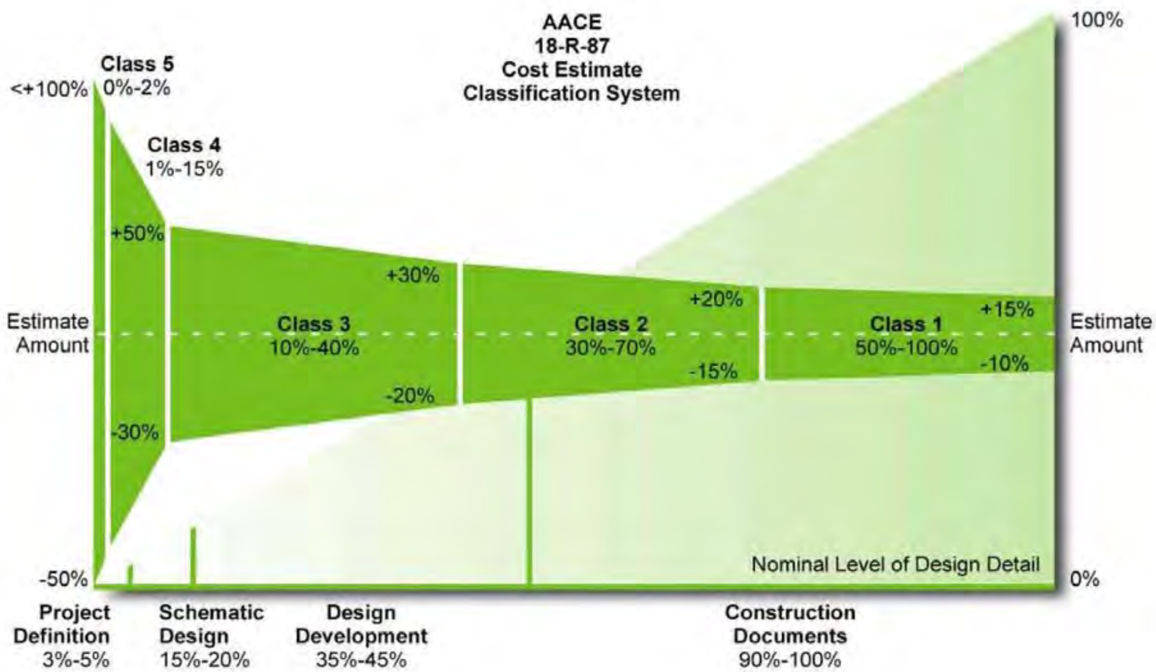
USACE will manage the bidding phase (estimated by the USACE to take about 6 months) and construction phases, with support anticipated from CH2M HILL. Construction is expected to take 18 months, resulting in an estimated completion date in August, 2016. Start-up and commissioning activities are expected to take place in summer of 2016.

5.4 Cost Estimate

The technical memoranda, drawings, and the remaining documents that make up this PDDR form the basis for the capital cost estimate for the overall project. This estimating effort adopts the classification of estimates as defined by the Association for the Advancement of Cost Engineering (AACE). The industry classification system is Recommended Practice-17R-97: "Cost Estimate Classification System" and 18R-97: "Cost Estimating Classification System as Applied in Engineering, Procurement, and Construction for the Process Industries." This cost estimating approach was used during this Project Design Definition phase to more easily enable cost screening of evaluations to be conducted to establish appropriate design criteria. All cost estimates for future design phases will be prepared using the USACE MCACES II cost estimating system.

Figure 5-2 shows the relationship of level of detail to the expected accuracy of the estimate.

Figure 5-2
Construction Cost Estimate Accuracy Ranges



The capital costs within this PDDR are defined as order-of-magnitude-level (Class 4) cost estimates defined by AACE and adopted by the American National Standards Institute. An estimate of this type is normally expected to be within +50 percent to -30 percent of the actual construction cost. Based on our understanding of the existing CTP facility and its necessary upgrades, CH2M HILL staff believe the capital cost estimate documented in this TM has an estimated accuracy range of about +40 percent to – 25 percent. The capital cost estimate included in this TM does not include construction management or engineering services during construction. Table 5-1 summarizes the project design definition capital cost estimate.

Table 5-1
Construction Cost Estimate

+40%	Estimate Accuracy Range	-25%
	Construction – WWTP and Seepage Collection System	
$51,002,000	$36,430,000	$27,323000
	Temporary Treatment and Operational Cost	
$1,991,000	$1,422,000	$1,067,000
	Total Project Cost	
$52,993,000	$37,852,000	$28,389,000

See Attachment 5-A for a detailed breakdown of the PDDR capital cost estimate.

This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, final project costs, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

5.5 Areas of Cost Uncertainty

This PDDR capital cost estimate assumes design upgrades necessary to meet the expected future effluent discharge limits as described in the 2012 ROD Amendment and as reiterated in TM 1. In addition, TM 1 describes possible alternate approaches to establishing different effluent discharge limits (e.g., the potential for a mixing zone, effluent limits specific to differing flow-tiers, compliance schedule, etc.) that could result in less costly capital upgrades needed to treat certain difficult to treat parameters. During the Schematic Design phase, USEPA will lead the effort to determine the discharge requirements that will apply to the CTP upgrades. The design of the upgrades will be modified, as needed, if the discharge requirements change from those assumed in the ROD Amendment and TM 1. Currently, known components of the capital cost estimate that could change as a result of actual effluent limits for the CTP include:

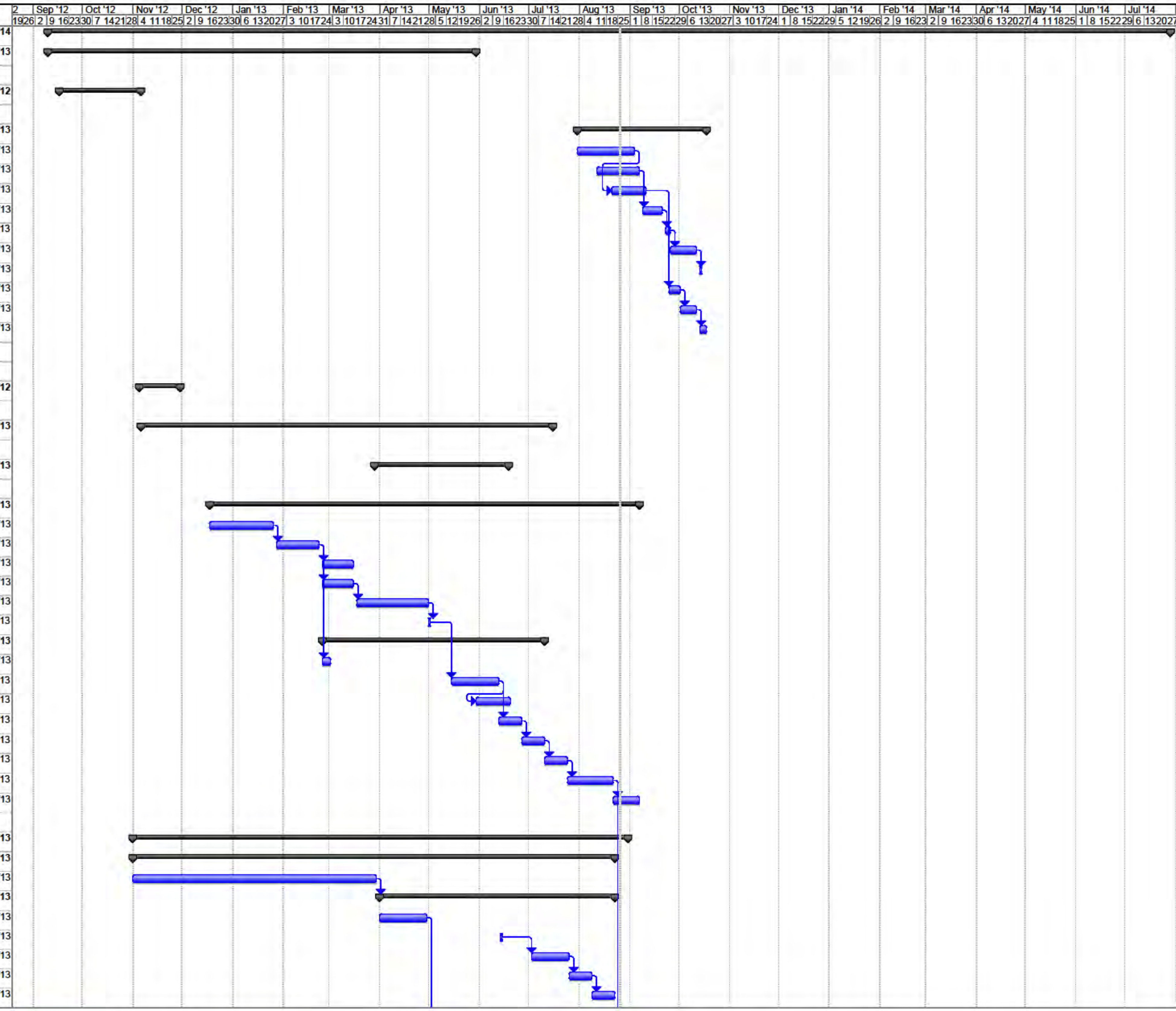
- Hydrosulfide feed system - will this system be needed to treat thallium?
- Hydrochloric acid feed system - will this system be needed to adjust discharge pH?
- Effluent discharge - will an in-stream pipe and outfall diffuser be needed if a mixing zone is granted?
- Selenium treatment (not included in current cost estimate) – will a treatment process specific to selenium need to be added if selenium is found to be present in mine water and/or if a mixing zone is granted?

In addition to the process engineering-related issues identified above, there are known geotechnical areas of cost uncertainty that will be evaluated during Schematic Design, including:

- Whether pile foundations are needed beneath the filter and blower buildings to address settlement concerns.
- Whether preloading the subsurface materials will be sufficient to address anticipated future settlement in areas currently assumed for piles.
- Depending on the depth and footprint of certain below-grade structures, to what extent will sheeting/shoring and dewatering be necessary?

CIA Drain RD
Final Design Schedule

ID	Task Name	Duration	Start	Finish
1	**CIA Collection and Treatment Remedial Design**	**480 days?**	**Mon 9/10/12**	**Mon 7/28/14**
2	**Groundwater Modeling**	**179 days**	**Mon 9/10/12**	**Wed 5/29/13**
13				
14	**Field Work - Fall 2012**	**36 days**	**Mon 9/17/12**	**Mon 11/5/12**
24				
25	**Supplemental Field Work - Fall 2013**	**57 days**	**Wed 7/31/13**	**Thu 10/17/13**
26	Field Planning - Prepare SPAF	25 days	Wed 7/31/13	Tue 9/3/13
27	Subcontractor Procurement - Bid Advertise and Award	20 days	Mon 8/12/13	Fri 9/6/13
28	Coordinate ROE for borings and MWs	15 days	Wed 8/21/13	Tue 9/10/13
29	Subcontractor Mobilization - Geotech	10 days	Mon 9/9/13	Fri 9/20/13
30	Site Reconnaissance. Mark drilling locations. Conduct utility locate.	3 days	Mon 9/23/13	Wed 9/25/13
31	Geotechnical investigation - GWCS Borings	12 days	Thu 9/26/13	Fri 10/11/13
32	Geotechnical investigation - GWCS Test Pits	1 day	Mon 10/14/13	Mon 10/14/13
33	Subcontractor Mobilization - Monitor Wells	5 days	Wed 9/25/13	Tue 10/1/13
34	Hydrogeologic investigation - Drill and Install Monitor Wells	8 days	Wed 10/2/13	Fri 10/11/13
35	Hydrologic investigation -Well development	4 days	Mon 10/14/13	Thu 10/17/13
36				
37				
38	**Sample Management**	**17 days**	**Mon 11/5/12**	**Thu 11/29/12**
43				
44	**Data Management**	**169 days**	**Tue 11/6/12**	**Mon 7/15/13**
52				
53	**Project Management**	**57 days?**	**Fri 3/29/13**	**Tue 6/18/13**
60				
61	**GW Collection Preliminary Design**	**180 days**	**Tue 12/18/12**	**Fri 9/6/13**
62	Prepare for Jan 25 technical briefing - prelim drain configuration	23 days	Tue 12/18/12	Fri 1/25/13
63	Evaluate Geochemistry Issues - post Jan 25 workshop	20 days	Mon 1/28/13	Fri 2/22/13
64	Evaulate System Hydraulics and Optimize Layout	15 days	Mon 2/25/13	Fri 3/15/13
65	Evaulate Drain Trench and Oxy Minimize Trench Options	15 days	Mon 2/25/13	Fri 3/15/13
66	Final groundwater model simulations and design modifications	32 days	Mon 3/18/13	Tue 4/30/13
67	EPA Briefing	1 day	Wed 5/1/13	Wed 5/1/13
68	**Prepare Draft Design Definition Report**	**95 days**	**Mon 2/25/13**	**Wed 7/10/13**
69	Prepare Outline	5 days	Mon 2/25/13	Fri 3/1/13
70	Provide minimal internal decision documentation	20 days	Wed 5/15/13	Wed 6/12/13
71	EPA_Corps Comment period -critical comment review	15 days	Thu 5/30/13	Wed 6/19/13
72	Prepare Draft Design Def. for CH2M Internal Review	10 days	Thu 6/13/13	Wed 6/26/13
73	CH2M Internal Review - Fix-up	8 days	Thu 6/27/13	Wed 7/10/13
74	EPA/USACE/DEQ - Technical Review Workshop and Review Period - Draft Design Def	10 days	Thu 7/11/13	Wed 7/24/13
75	Respond to EPA/USACE comments	20 days	Thu 7/25/13	Wed 8/21/13
76	Ajudicate Comments and Prepare Final Design Definition Report	12 days	Thu 8/22/13	Fri 9/6/13
77				
78	**CTP Preliminary Design**	**206 days?**	**Thu 11/1/12**	**Fri 8/30/13**
79	**CTP Pilot Studies and Preliminary Design Review**	**200 days?**	**Thu 11/1/12**	**Thu 8/22/13**
80	Pilot_Treatability Studies	99 days?	Thu 11/1/12	Fri 3/29/13
81	**Pilot Studies and High Flow Sampling Report**	**101 days**	**Mon 4/1/13**	**Thu 8/22/13**
82	Interim Pilot Studies Findings TM	21 days	Mon 4/1/13	Mon 4/29/13
83	EPA/USACE Briefing	1 day	Fri 6/14/13	Fri 6/14/13
84	Draftl Treatability Studies Report	15 days	Wed 7/3/13	Thu 7/25/13
85	EPA/USACE Review	10 days	Fri 7/26/13	Thu 8/8/13
86	Final Treatability Studies Report	10 days	Fri 8/9/13	Thu 8/22/13

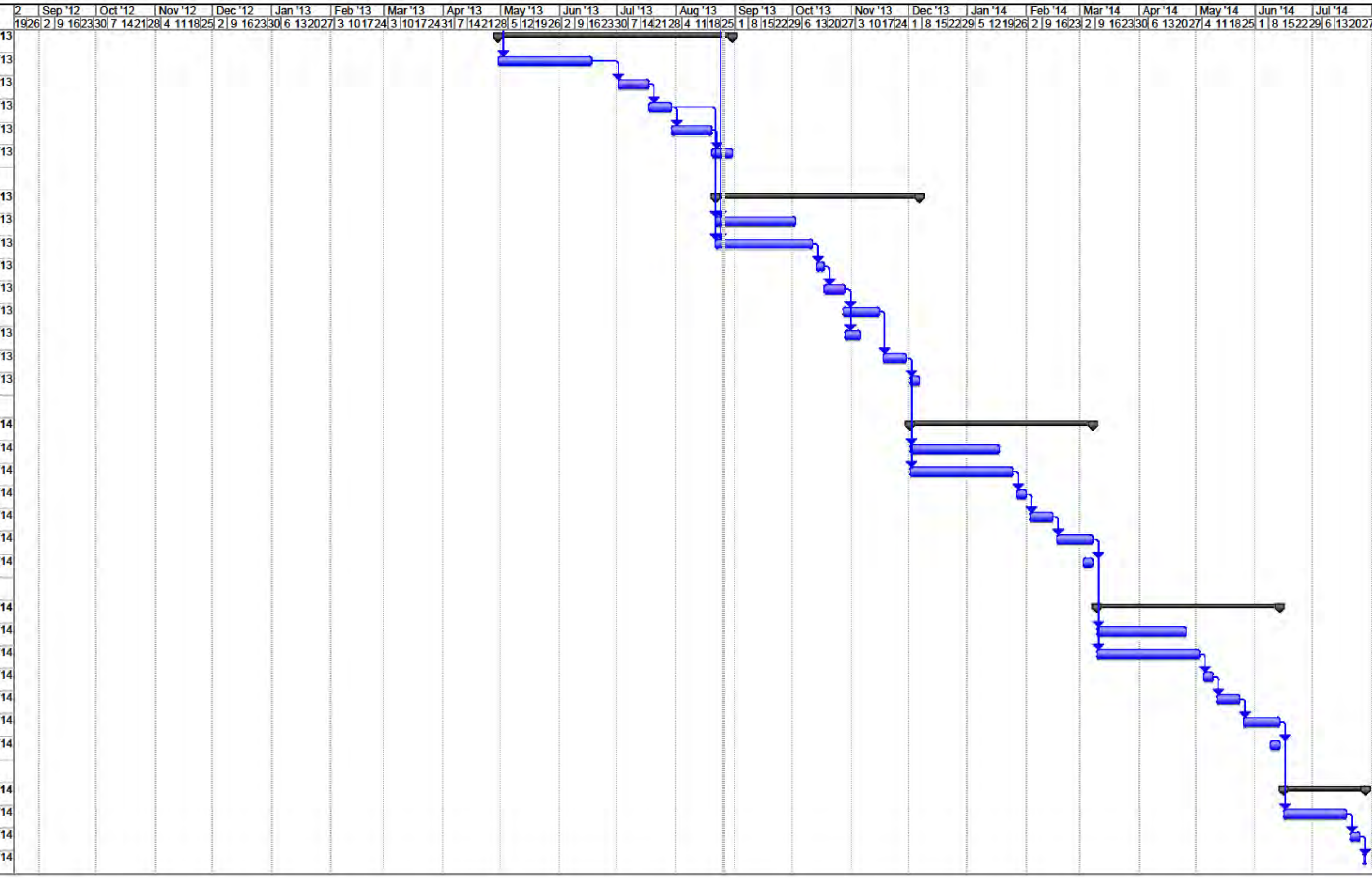


Project: CIA Drain RD
Date: Mon 8/26/13

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

CIA Drain RD
Final Design Schedule

ID	Task Name	Duration	Start	Finish
87	**Project Design Definition (PDD) Report**	**86 days**	**Tue 4/30/13**	**Fri 8/30/13**
88	Draft PDD Report	34 days	Tue 4/30/13	Mon 6/17/13
89	EPA/USACE/DEQ - Technical Review Workshop and Review Period	10 days	Tue 7/2/13	Wed 7/17/13
90	Respond to EPA/USACE comments	8 days	Thu 7/18/13	Mon 7/29/13
91	Ajudicate EPA/USACE Comments	15 days	Tue 7/30/13	Mon 8/19/13
92	Prepare Final Design Definition Report	9 days	Tue 8/20/13	Fri 8/30/13
93				
94	**Integrated CIA GW Collection and CTP Upgrade Schematic Design (SD) - 30%**	**77 days**	**Thu 8/22/13**	**Fri 12/6/13**
95	Prepare Schematic Design Report (30%) for Internal Review -Engineer Cutoff	30 days	Thu 8/22/13	Wed 10/2/13
96	Prepare Schematic Design Report (30%) for Internal Review - CAD Cutoff	37 days	Thu 8/22/13	Fri 10/11/13
97	Compile SDR Package (DM/PAL) and Perform Internal Review	4 days	Mon 10/14/13	Thu 10/17/13
98	CH2M Internal QC Review - Fix-up	7 days	Fri 10/18/13	Mon 10/28/13
99	**Submit SDR for USACE/EPA/DEQ comment review**	15 days	Mon 10/28/13	Fri 11/15/13
100	**SDR Design Review Workshop (target 11/5)**	6 days	Tue 10/29/13	Tue 11/5/13
101	Respond and Ajudicate EPA/USACE Ciomments	10 days	Mon 11/18/13	Fri 11/29/13
102	Prepare Final SDR	5 days	Mon 12/2/13	Fri 12/6/13
103				
104	**CIA Drain Final Design - Integrated with CTP - Design Development Phase - 60%**	**70 days**	**Mon 12/2/13**	**Fri 3/7/14**
105	Prepare DD Plans, Specs and Estimate (60%) for Internal Review - Engineer Cutoff	35 days	Mon 12/2/13	Fri 1/17/14
106	Prepare DD Plans, Specs and Estimate (60%) for Internal Review - CAD Cutoff	40 days	Mon 12/2/13	Fri 1/24/14
107	Compile DD Plans, Specs and Estimate (60%) for Internal Review	5 days	Mon 1/27/14	Fri 1/31/14
108	CH2M Internal Review - Fix-up	10 days	Mon 2/3/14	Fri 2/14/14
109	**Submit DD for USACE/EPA/DEQ comment review and adjudication**	15 days	Mon 2/17/14	Fri 3/7/14
110	**DD Design Review Workshop**	5 days	Mon 3/3/14	Fri 3/7/14
111				
112	**CIA Drain Final Design - Integrated with CTP - Contract Documents Phase - 90%**	**70 days**	**Mon 3/10/14**	**Fri 6/13/14**
113	Prepare CD Plans, Specs and Estimate (60%) for Internal Review - Engineer Cutoff	35 days	Mon 3/10/14	Fri 4/25/14
114	Prepare CD Plans, Specs and Estimate (60%) for Internal Review - CAD Cutoff	40 days	Mon 3/10/14	Fri 5/2/14
115	Compile CD Plans, Specs and Estimate (90%) for Internal Review	5 days	Mon 5/5/14	Fri 5/9/14
116	CH2M Internal Review - Fix-up	10 days	Mon 5/12/14	Fri 5/23/14
117	**Submit CD for USACE/EPA/DEQ comment review and adjudication**	15 days	Mon 5/26/14	Fri 6/13/14
118	**CD Design Review Workshop**	5 days	Mon 6/9/14	Fri 6/13/14
119				
120	**CIA Drain Final Design - Integrated with CTP - Final Fix-Up Phase - 100%**	**31 days**	**Mon 6/16/14**	**Mon 7/28/14**
121	Prepare FX Plans, Specs and Estimate (100%) for Final DM Check	25 days	Mon 6/16/14	Fri 7/18/14
122	CH2M Fix-up Review	5 days	Mon 7/21/14	Fri 7/25/14
123	**Submit Bid-Ready (100%) Contract Documents to USACE/EPA/DEQ**	1 day	Mon 7/28/14	Mon 7/28/14



Project: CIA Drain RD
Date: Mon 8/26/13

Task		Milestone	◆	Rolled Up Task		Rolled Up Progress		External Tasks		Group By Summary	
Progress		Summary		Rolled Up Milestone	◇	Split		Project Summary		Deadline	⇩

Attachment 5-A

Bunker Hill CTP

Construction Cost Estimate and Temporary Treatment Cost (b)(4) 1-95

WWTP Facility		**Cost**
A Reactor		$
B Reactors (two)		$
B Reactor Blowers		$
Filter Feed Pump Station		$
Filters		$
Filter Backwash Supply Pumps		$
Backwash Waste Pump Station		$
Sludge Recycle Pumps - Allowance		$
Sludge Waste Pumps - Allowance		$
Emergency Generator (750 Kw)		$
Polymer Feed System		$
Hydrochloric Acid Feed System		$
Sodium Hydrosulfide Feed System		$
Effluent Pump Station		$
Effluent Pipeline		$
Effluent Outfall Structure - Allowance		$
WWTP Subtotal Treatment Costs		**$**
Amount Applicable to State Sale Tax	60%	$
Idaho State Sales Tax	6%	$
WWTP Costs with State Sales Tax		**$**
WWTP Project and Site Specific Allowances:		
Clear Well Flushing Water Pump (1ea)		$
Thickener Modifications Allowance		$
Demolition Costs:		$
Demo Pond, Building Structur and Building Relocation		$
Demo Rapid Mix, Aeration Basin, Flocc Tank, Sludge Piping and Lime Slurry Piping		$
Transformer (750kVa) & ATS		$
Pile Foundations - Filter Building		$
Pile Foundations - Blower/Polymer Building		$
Sheeting and Shoring		$
Dewatering		$
Two Story Structural for Filter Building - Allowance		$
WWTP Allowance Subtotal		**$**
WWTP Treatment and Allowance Subtotal		**$**

26-Jun-2013

Bunker Hill CTP

Construction Cost Estimate and Temporary Treatment Cost (b)(4) 1-95

Sitework Items:		
Overall Sitework	2.00%	$
Overall Site Electrical	2.00%	$
Plant Computer System & DCS	0.50%	$
Yard Piping	1.75%	$
Subtotal Site Items		$
Subtotal WWTP, Allowance and Site Items		$
Seepage Collection System - 12 wells, long groundwater cutoff wall around SPA		$
Subtotal WWTP and Seepage system		$
Contractor Markups:		
General Requirements	7%	$
Subtotal		$
Overhead	8%	$
Subtotal		$
Profit	7%	$
Subtotal		$
Mod/Bonds/Insurance	5%	$
Subtotal		$
Contingency	15%	$
Subtotal		$
Escalation	7.18%	$
Subtotal		$
Location Adjustment Factor	94	$
Total - WWTP and Seepage System		$

Bunker Hill CTP

Construction Cost Estimate and Temporary Treatment Cost

(b)(4) 1-95

TEMPORARY TREATMENT COSTS:			
Skid Mounted Treatment Rental - Allowance per Month		$	
Temporary Treatment Costs	9 MO	$	
Temporary Treatment Operational Cost per Month (see detail)		$	
Temporary Operational Costs	9 MO	$	
Analytical Testing	9 MO	$	
Total Temporary Costs		$	
TOTAL PROJECT COSTS		$	

	B	C	D	E	F	G	H
1	***IWP Steel Mixing Tanks***						
301							
302	Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
303						(b)(4) 1-95	
304	SITEWORK:						
305	Tank Area:						
306	Excavation	26.85	CY	20.53	m3		
307	Imported Structural Backfill	19.20	CY	14.68	m3		
308	Native Backfill	4.77	CY	3.65	m3		
309	Haul Excess	22.08	CY	16.88	m3		
310	Electrical Building:						
311	Excavation	15.30	CY	11.70	m3		
312	Imported Structural Backfill	10.06	CY	7.69	m3		
313	Native Backfill	3.60	CY	2.76	m3		
314	Haul Excess	11.70	CY	8.94	m3		
315	Allowance for Misc Items	5%					
316	Subtotal						
317							
318	CONCRETE:						
319	Slab on Grade	9.60	CY	7.34	m3		
320	Pipe Supports	7	EA				
321	Electrical Room Slab on Grade	5.03	CY	3.84	m3		
322	Allowance for Misc Items	5%					
323	Subtotal						
324							
325	MASONRY:	Moderate					
326	CMU Building	0.00	SF	0.00	m2		
327	Electrical Room	54.44	SF	5.06	m2		
328	Subtotal	54.44					
329							
330	METALS:						
331	Canopy	0.00	SF	0.00	m2		
332	Tank Lids:						
333	Tank 1	0.00	SF	0.00	m2		
334	Tank 2	0.00	SF	0.00	m2		
335	Tank 3	0.00	SF	0.00	m2		
336	Tank 4	0.00	SF	0.00	m2		
337	Tank 5	0.00	SF	0.00	m2		
338	Tank 6	0.00	SF	0.00	m2		
339	Tank 7	0.00	SF	0.00	m2		
340	Tank 8	0.00	SF	0.00	m2		
341	Allowance for Misc Items	10%					
342	Subtotal						
343							
344	EQUIPMENT:						
345	Tanks:						
346	Tank 1 (Rapid Mix)	1	EA				
347	Tank 2 ()	0	EA				
348	Tank 3 ()	0	EA				
349	Tank 4 ()	0	EA				
350	Tank 5 ()	0	EA				
351	Tank 6 ()	0	EA				
352	Tank 7 ()	0	EA				
353	Tank 8 ()	0	EA				
354	Tank Mixers:						
355	Tank 1 Mixer	2.02	HP	1.50	kW		
356	Tank 2 Mixer	0.00	HP	0.00	kW		
357	Tank 3 Mixer	0.00	HP	0.00	kW		
358	Tank 4 Mixer	0.00	HP	0.00	kW		
359	Tank 5 Mixer	0.00	HP	0.00	kW		
360	Tank 6 Mixer	0.00	HP	0.00	kW		
361	Tank 7 Mixer	0.00	HP	0.00	kW		
362	Tank 8 Mixer	0.00	HP	0.00	kW		
363	Allowance for Misc Items	10%					
364	Subtotal						
365							
366	INSTRUMENTS & CONTROLS:						
367	Instruments						
368	Level Switches	1	EA				
369	Number of Analog I/O Counts	2	EA				
370	Number of Digital I/O Counts	5	EA				
371	Number of PLC's	1	EA				
372	I&C Conduit & Wire	34.20	LF	10.42	m		
373	Allowance for Misc Items	10%					
374	Subtotal						
375							
376	MECHANICAL:						

	B	C	D	E	F	G	H
1	***IWP Steel Mixing Tanks***						
377	Pipe:						
378	Header Pipe (Feed and Discharge) (8-inch, FHP, Exposed ,Carbon Steel ,Cement Mortar ,Paint)	9.10	LF	2.77	m	(b)(4) 1-95 [redacted]	
379	Lateral Pipe (8-inch, LP, Exposed ,Carbon Steel ,Cement Mortar ,Paint)	10.00	LF	3.05	m		
380	Elbows:						
381	Header Pipe (Feed and Discharge) (8-inch)	0	EA				
382	Lateral Pipe (8-inch)	0	EA				
383	Valves:						
384	Header Isolation Valves (8-inch)	2	EA				
385	Tank Isolation Valves (8-inch)	2	EA				
386	Allowance for Misc Items	10%					
387	Subtotal						
388							
389	ELECTRICAL:						
390	MCC's						
391	Sections	5	EA				
392	AFD's						
393	Tank 1 Mixer	0	EA				
394	Tank 2 Mixer	0	EA				
395	Tank 3 Mixer	0	EA				
396	Tank 4 Mixer	0	EA				
397	Tank 5 Mixer	0	EA				
398	Tank 6 Mixer	0	EA				
399	Tank 7 Mixer	0	EA				
400	Tank 8 Mixer	0	EA				
401	Switchgear						
402	Units	0	EA				
403	Electrical Conduit & Wire	28.20	LF	8.60	m		
404	Allowance for Misc Items	10%					
405	Subtotal						
406							
407	**USER DEFINED ESTIMATE ITEMS:**	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**		
408	Item 1 Description	0.00		0.00			
409	Item 2 Description	0.00		0.00			
410	Item 3 Description	0.00		0.00			
411	Item 4 Description	0.00		0.00			
412	Item 5 Description	0.00		0.00			
413	Item 6 Description	0.00		0.00			
414	Item 7 Description	0.00		0.00			
415	Item 8 Description	0.00		0.00			
416	Item 9 Description	0.00		0.00			
417	Item 10 Description	0.00		0.00			
418	Item 11 Description	0.00		0.00			
419	Item 12 Description	0.00		0.00			
420	Item 13 Description	0.00		0.00			
421	Item 14 Description	0.00		0.00			
422	Item 15 Description	0.00		0.00			
423	Subtotal						
424							
425	Subtotal						
426							
427	ALLOWANCES:		**User Over-write**	(b) (4) [redacted]			
428	Finishes Allowance	2.00%					
429	I & C Allowance	4.00%					
430	Mechanical Allowance	5.00%					
431	Electrical Allowance	4.00%					
432							
433	Facility Cost	**777,600**	**GPD**				
434	Facility Cost with Standard Additional Project Costs Added	**777,600**	**GPD**				
435	Facility Cost with Standard Additional Project Costs & Contractor Markups Added	**777,600**	**GPD**				
436	Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	**777,600**	**GPD**				
437	Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added (excluding ALL Additional Project Costs)	**777,600**	**GPD**				
438	Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**777,600**	**GPD**				

	B	C	D	E	F	G	H
1	***IWP Steel Mixing Tanks***						
301							
302	Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
303							
304	SITEWORK:						
305	Tank Area:					(b)(4) 1-95 [redacted]	
306	Excavation	309.20	CY	236.40	m3		
307	Imported Structural Backfill	257.78	CY	197.09	m3		
308	Native Backfill	18.30	CY	13.99	m3		
309	Haul Excess	290.91	CY	222.41	m3		
310	Electrical Building:						
311	Excavation	15.30	CY	11.70	m3		
312	Imported Structural Backfill	10.06	CY	7.69	m3		
313	Native Backfill	3.60	CY	2.76	m3		
314	Haul Excess	11.70	CY	8.94	m3		
315	Allowance for Misc Items	5%					
316	Subtotal						
317							
318	CONCRETE:						
319	Slab on Grade	128.89	CY	98.54	m3		
320	Pipe Supports	7	EA				
321	Electrical Room Slab on Grade	5.03	CY	3.84	m3		
322	Allowance for Misc Items	5%					
323	Subtotal						
324		Moderate					
325	MASONRY:						
326	CMU Building	0.00	SF	0.00	m2		
327	Electrical Room	54.44	SF	5.06	m2		
328	Subtotal	54.44					
329							
330	METALS:						
331	Canopy	0.00	SF	0.00	m2		
332	Tank Lids:						
333	Tank 1	0.00	SF	0.00	m2		
334	Tank 2	0.00	SF	0.00	m2		
335	Tank 3	0.00	SF	0.00	m2		
336	Tank 4	0.00	SF	0.00	m2		
337	Tank 5	0.00	SF	0.00	m2		
338	Tank 6	0.00	SF	0.00	m2		
339	Tank 7	0.00	SF	0.00	m2		
340	Tank 8	0.00	SF	0.00	m2		
341	Allowance for Misc Items	10%					
342	Subtotal						
343							
344	EQUIPMENT:						
345	Tanks:						
346	Tank 1 (Rapid Mix)	1	EA				
347	Tank 2 (Rapid Mix)	1	EA				
348	Tank 3 ()	0	EA				
349	Tank 4 ()	0	EA				
350	Tank 5 ()	0	EA				
351	Tank 6 ()	0	EA				
352	Tank 7 ()	0	EA				
353	Tank 8 ()	0	EA				
354	Tank Mixers:						
355	Tank 1 Mixer	119.07	HP	88.79	kW		
356	Tank 2 Mixer	119.07	HP	88.79	kW		
357	Tank 3 Mixer	0.00	HP	0.00	kW		
358	Tank 4 Mixer	0.00	HP	0.00	kW		
359	Tank 5 Mixer	0.00	HP	0.00	kW		
360	Tank 6 Mixer	0.00	HP	0.00	kW		
361	Tank 7 Mixer	0.00	HP	0.00	kW		
362	Tank 8 Mixer	0.00	HP	0.00	kW		
363	Allowance for Misc Items	10%					
364	Subtotal						
365							
366	INSTRUMENTS & CONTROLS:						
367	Instruments						
368	Level Switches	2	EA				
369	Number of Analog I/O Counts	5	EA				
370	Number of Digital I/O Counts	10	EA				
371	Number of PLC's	1	EA				
372	I&C Conduit & Wire	324.00	LF	98.76	m		
373	Allowance for Misc Items	10%					
374	Subtotal						
375							
376	MECHANICAL:						

	B	C	D	E	F	G	H
1	***IWP Steel Mixing Tanks***						
377	Pipe:						
378	Header Pipe (Feed and Discharge) (30-inch, FHP, Exposed ,Carbon Steel ,Cement Mortar ,Paint)	36.50	LF	11.13	m	(b)(4) 1-95 [redacted]	
379	Lateral Pipe (30-inch, LP, Exposed ,Carbon Steel ,Cement Mortar ,Paint)	15.00	LF	4.57	m		
380	Elbows:						
381	Header Pipe (Feed and Discharge) (30-inch)	0	EA				
382	Lateral Pipe (30-inch)	0	EA				
383	Valves:						
384	Header Isolation Valves (30-inch)	2	EA				
385	Tank Isolation Valves (30-inch)	4	EA				
386	Allowance for Misc Items	10%					
387	Subtotal						
388							
389	ELECTRICAL:						
390	MCC's						
391	Sections	5	EA				
392	AFD's						
393	Tank 1 Mixer	0	EA				
394	Tank 2 Mixer	0	EA				
395	Tank 3 Mixer	0	EA				
396	Tank 4 Mixer	0	EA				
397	Tank 5 Mixer	0	EA				
398	Tank 6 Mixer	0	EA				
399	Tank 7 Mixer	0	EA				
400	Tank 8 Mixer	0	EA				
401	Switchgear						
402	Units	0	EA				
403	Electrical Conduit & Wire	312.00	LF	95.10	m		
404	Allowance for Misc Items	10%					
405	Subtotal						
406							
407	**USER DEFINED ESTIMATE ITEMS:**	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**		
408	Structural Platform - Assumed 15' x 20'	300.00	SF				
409	Item 2 Description	0.00		0.00			
410	Item 3 Description	0.00		0.00			
411	Item 4 Description	0.00		0.00			
412	Item 5 Description	0.00		0.00			
413	Item 6 Description	0.00		0.00			
414	Item 7 Description	0.00		0.00			
415	Item 8 Description	0.00		0.00			
416	Item 9 Description	0.00		0.00			
417	Item 10 Description	0.00		0.00			
418	Item 11 Description	0.00		0.00			
419	Item 12 Description	0.00		0.00			
420	Item 13 Description	0.00		0.00			
421	Item 14 Description	0.00		0.00			
422	Item 15 Description	0.00		0.00			
423	Subtotal						
424							
425	Subtotal						
426							
427	ALLOWANCES:		**User Over-write**	(b)(4) 1-95 [redacted]			
428	Finishes Allowance	2.00%					
429	I & C Allowance	4.00%					
430	Mechanical Allowance	5.00%					
431	Electrical Allowance	4.00%					
432							
433	Facility Cost	**13,188,960**	**GPD**				
434	Facility Cost with Standard Additional Project Costs Added	**13,188,960**	**GPD**				
435	Facility Cost with Standard Additional Project Costs & Contractor Markups Added	**13,188,960**	**GPD**				
436	Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	**13,188,960**	**GPD**				
437	Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added (excluding ALL Additional Project Costs)	**13,188,960**	**GPD**				
438	Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**13,188,960**	**GPD**				

Blower Building

COST ESTIMATE

(b)(4) 1-95

DESCRIPTION	QUANTITY (ENGLISH)	UNIT (ENGLISH)	QUANTITY (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST
SITEWORK:						
Excavation	186.50	CY	142.59	m3		
Imported Structural Backfill	146.07	CY	111.68	m3		
Native Backfill	20.44	CY	15.63	m3		
Haul Excess	166.06	CY	126.96	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Slab on Grade	60.00	CY	45.87	m3		
Allowance for Misc Items	5%					
Subtotal						
MASONRY:	Moderate					
CMU Building	1300.00	SF	120.77	m2		
Subtotal						
EQUIPMENT:						
Aeration Blower (1276 scfm, 84 hp per each)	3.00	EA				
Digester Blower (0 scfm, 0 hp per each)	0.00	EA				
Allowance for Misc Items	10%					
Subtotal						
INSTRUMENTS & CONTROLS:						
Instruments						
Isolation Valve Actuators	12.00	EA				
Control Valve Actuators	1.00	EA				
Air Differential Pressure Transmitter	3.00	EA				
Air Discharge Pressure Indicator Transmitter	3.00	EA				
Number of Analog I/O Counts	29.00	EA				
Number of Digital I/O Counts	84.00	EA				
Number of PLC's	1.00	EA				
I&C Conduit & Wire	950.00	LF	289.56	m		
Allowance for Misc Items	10%					
Subtotal						
CONVEYING SYSTEMS:						
Monorail	50.00	LF	15.24	m		
Monorail Craine	1.00	EA				
Allowance for Misc Items	10%					
Subtotal						
MECHANICAL:						
Pipe:						
Aeration Basin Blowers						
Blower Suction Air Piping (8 inches diameter)	22.00	LF	6.71	m		
Discharge Bypass Air Piping (8 inches diameter)	14.00	LF	4.27	m		
Discharge Bypass Header Air Piping (12 inches diameter)	40.00	LF	12.19	m		
Blower Discharge Air Piping (8 inches diameter)	15.00	LF	4.57	m		
Discharge Header Air Piping (12 inches diameter)	140.00	LF	42.67	m		
Aerobic Digester Blowers						
Not Applicable	0.00	LF	0.00	m		
Not Applicable	0.00	LF	0.00	m		
Not Applicable	0.00	LF	0.00	m		
Not Applicable	0.00	LF	0.00	m		
Not Applicable	0.00	LF	0.00	m		
Elbows:						
Aeration Basin Blowers						
Blower Suction Air Piping (8 inches diameter)	9.00	EA				
Discharge Bypass Air Piping (8 inches diameter)	6.00	EA				
Discharge Bypass Header Air Piping (12 inches diameter)	9.00	EA				
Blower Discharge Air Piping (8 inches diameter)	6.00	EA				
Discharge Header Air Piping (12 inches diameter)	6.00	EA				
Aerobic Digester Blowers						
Not Applicable	0.00	EA				
Not Applicable	0.00	EA				
Not Applicable	0.00	EA				
Not Applicable	0.00	EA				
Not Applicable	0.00	EA				
Tees:						
Aeration Basin Blowers						
Blower Suction Air Piping (8 inches diameter)	0.00	EA				
Discharge Bypass Air Piping (8 inches diameter)	3.00	EA				
Discharge Bypass Header Air Piping (12 inches diameter)	0.00	EA				
Blower Discharge Air Piping (8 inches diameter)	3.00	EA				
Discharge Header Air Piping (12 inches diameter)	2.00	EA				
Aerobic Digester Blowers						
Not Applicable	0.00	EA				
Not Applicable	0.00	EA				
Not Applicable	0.00	EA				
Not Applicable	0.00	EA				
Not Applicable	3.00	EA				
Valves:						
Aeration Basin Blowers						
Blower Suction Air Piping (8 inches diameter)	3.00	EA				
Discharge Bypass Air Piping (8 inches diameter)	3.00	EA				
Discharge Bypass Header Air Piping (12 inches diameter)	0.00	EA				

(b)(4) 1-95 [redacted]

Blower Building					
Blower Discharge Air Piping (8 inches diameter)	6.00	EA			[redacted]
Discharge Header Air Piping (12 inches diameter)	0.00	EA			
Aerobic Digester Blowers					
Not Applicable	0.00	EA			
Not Applicable	0.00	EA			
Not Applicable	0.00	EA			
Not Applicable	0.00	EA			
Not Applicable	0.00	EA			
Allowance for Misc Items	5%				
Subtotal					
ELECTRICAL:					
MCC's					
Sections	5.00	EA			
AFD's					
Aeration Blower (Active) (84 hp each)	2.00	EA			
Aeration Blower (Standby) (84 hp each)	1.00	EA			
Digester Blower (Active) (0 hp each)	0.00	EA			
Digester Blower (Standby) (0 hp each)	0.00	EA			
User Defined Item #1 (0 hp each)	0.00	EA			
User Defined Item #2 (0 hp each)	0.00	EA			
Switchgear					
Units	0.00	EA			
Electrical Conduit & Wire	150.00	LF	45.72	m	
Allowance for Misc Items	5%				
Subtotal					
USER DEFINED ESTIMATE ITEMS.	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	
Item 1 Description	0		0		
Item 2 Description	0		0		
Item 3 Description	0		0		
Item 4 Description	0		0		
Item 5 Description	0		0		
Item 6 Description	0		0		
Item 7 Description	0		0		
Item 8 Description	0		0		
Item 9 Description	0		0		
Item 10 Description	0		0		
Item 11 Description	0		0		
Item 12 Description	0		0		
Item 13 Description	0		0		
Item 14 Description	0		0		
Item 15 Description	0		0		
Subtotal					
Subtotal					
ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]		
Finishes Allowance	2.00%				
I & C Allowance	2.00%				
Mechanical Allowance	2.00%				
Electrical Allowance	2.00%				
Facility Cost	3,828.0	SCFM			
Facility Cost with Standard Additional Project Costs Added	3,828.0	SCFM			
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	3,828.0	SCFM			
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	3,828.0	SCFM			
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added (excluding ALL Additional Project Costs)	3,828.0	SCFM			
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	3,828.0	SCFM			

Wet Pit Submersible Pump Station

COST ESTIMATE

(b)(4) 1-95

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:						
Operating Room:						
Excavation	59.08	CY	45.17	m3		
Imported Structural Backfill	96.68	CY	73.92	m3		
Native Backfill	4.41	CY	3.37	m3		
Haul Excess	54.67	CY	41.80	m3		
Wet Well:						
Excavation	2633.00	CY	2013.07	m3		
Imported Structural Backfill	53.18	CY	40.66	m3		
Native Backfill	1627.71	CY	1244.47	m3		
Haul Excess	1005.29	CY	768.60	m3		
Surge Protection:						
Excavation	42.76	CY	32.70	m3		
Imported Structural Backfill	29.34	CY	22.43	m3		
Native Backfill	8.84	CY	6.76	m3		
Haul Excess	33.92	CY	25.93	m3		
Hatch Access Room:						
Excavation	7.66	CY	5.85	m3		
Imported Structural Backfill	4.30	CY	3.28	m3		
Native Backfill	2.54	CY	1.94	m3		
Haul Excess	5.12	CY	3.91	m3		
Electrical Room:						
Excavation	40.10	CY	30.66	m3		
Imported Structural Backfill	27.27	CY	20.85	m3		
Native Backfill	8.53	CY	6.52	m3		
Haul Excess	31.57	CY	24.14	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Operating Room						
Foundation	54.23	CY	41.47	m3		
Pipe Supports	0.88	CY	0.67	m3		
Electrical Room						
Foundation	8.11	CY	6.20	m3		
Surge Protection						
Foundation	9.29	CY	7.11	m3		
Pump Station Wet Well						
Floor Slab	38.47	CY	29.41	m3		
Wet Well Walls	114.67	CY	87.67	m3		
Ceiling Slab	19.23	CY	14.70	m3		
Pump Baffling	5.16	CY	3.94	m3		
Inlet Slope	6.57	CY	5.02	m3		
Pipe Support Fitting	13.86	CY	10.60	m3		
Hatch Access Room						
Foundation	1.96	CY	1.50	m3		
Allowance for Misc Items	5%					
Subtotal						
MASONRY:	Moderate					
Operating Room	1494.41	SF	138.84	m2		
Hatch Access Room	0.00	SF	0.00	m2		
Surge Building	0.00	SF	0.00	m2		
Electrical Room	218.91	SF	20.34	m2		
Subtotal	1713.32					
METALS:						
Pump Removal Hatches	67.05	SF	6.23	m2		
Stairs	20.00	Risers				
Access Hatch Ladder	24.20	VLF	7.38	VLM		
Allowance for Misc Items	10%					
Subtotal						
THERMAL & MOISTURE PROTECTION:						
Wet Well Liner	0.00	SF	0.00	m2		
Allowance for Misc Items	10%					
Subtotal						
EQUIPMENT:						
Pumps						
Active Pump # 1	1.00	EA				
Active Pump # 2	1.00	EA				
Active Pump # 3	0.00	EA				
Active Pump # 4	0.00	EA				
Active Pump # 5	0.00	EA				
Active Pump # 6	0.00	EA				
Active Pump # 7	0.00	EA				
Standby Pump	1.00	EA				
Allowance for Misc Items	10%					
Subtotal						

Wet Pit Submersible Pump Station

INSTRUMENTATION & CONTROLS:					
Instruments					(b)(4) 1-95 [redacted]
Isolation Valve Actuators	4.00	EA			
Control Valve Actuators	3.00	EA			
Level Indicator Transmitters	2.00	EA			
Level Swithces	0.00	EA			
Pressure Indicator Transmitters	1.00	EA			
Pressure Switches	3.00	EA			
Number of Analog I/O Counts	19.20	EA			
Number of Digital I/O Counts	46.80	EA			
Number of PLC's	1.00	EA			
I&C Conduit & Wire	677.80	LF	206.59	m	
Allowance for Misc Items	10%				
Subtotal					
MECHANICAL:					
Pipe:					
Discharge Lateral Pipe (20-inch,DIS, Exposed, Steel, Cement Mortar, Paint)	48.00	LF	14.63	m	
Discharge Header Pipe (30-inch,DIS, Exposed/Buried, Steel, Cement Mortar, Paint)	40.94	LF	12.48	m	
Elbows:					
Pump Discharge (6-inch)	3.00	EA			
Discharge Lateral Pipe (20-inch)	3.00	EA			
Discharge Header Pipe (30-inch)	2.00	EA			
Tees:					
Discharge Header Pipe (30-inch)	3.00	EA			
Valves:					
Discharge Lateral Isolation Valve (20-inch - Butterfly Valve)	3.00	EA			
Pump Control Valve (20-inch, Check Valve)	3.00	EA			
Discharge Header Isolation Valve (30-inch, BFV)	1.00	EA			
Air Release Vacuum Valves	1.00	EA			
Increasers:					
Pump Discharge to Discharge Lateral (6-inch to 20-inch)	3.00	EA			
Discharge Lateral to Discharge Header (20-inch to 30-inch)	3.00	EA			
Allowance for Misc Items	10%				
Subtotal					
ELECTRICAL:					
MCC's					
Sections	5.00	EA			
AFD's					
Active Pump # 1	50.00	HP	37.28	kW	
Active Pump # 2	50.00	HP	37.28	kW	
Active Pump # 3	0.00	HP	0.00	kW	
Active Pump # 4	0.00	HP	0.00	kW	
Active Pump # 5	0.00	HP	0.00	kW	
Active Pump # 6	0.00	HP	0.00	kW	
Active Pump # 7	0.00	HP	0.00	kW	
Standby Pump	50.00	HP	37.28	kW	
Switchgear					
Units	0.00	EA			
Electrical Conduit & Wire	156.42	LF	47.68	m	
Allowance for Misc Items	5%				
Subtotal					
USER DEFINED ESTIMATE ITEMS:	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**	
Item 1 Description	0.00		0.00		
Item 2 Description	0.00		0.00		
Item 3 Description	0.00		0.00		
Item 4 Description	0.00		0.00		
Item 5 Description	0.00		0.00		
Item 6 Description	0.00		0.00		
Item 7 Description	0.00		0.00		
Item 8 Description	0.00		0.00		
Item 9 Description	0.00		0.00		
Item 10 Description	0.00		0.00		
Item 11 Description	0.00		0.00		
Item 12 Description	0.00		0.00		
Item 13 Description	0.00		0.00		
Item 14 Description	0.00		0.00		
Item 15 Description	0.00		0.00		
Subtotal					
Subtotal					

ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]	
Finishes Allowance	5.00%			
I & C Allowance	2.00%			
Surge Allowance	5.00%			
Mechanical Allowance	5.00%			
Electrical Allowance	5.00%			

(b)(4) 1-95

Wet Pit Submersible Pump Station					
Facility Cost	150	Total Pump HP	[redacted]		
Facility Cost with Standard Additional Project Costs Added	150	Total Pump HP	[redacted]		
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	150	Total Pump HP	[redacted]		
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	150	Total Pump HP	[redacted]		
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added *(excluding ALL Additional Project Costs)*	150	Total Pump HP	[redacted]		
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	150	Total Pump HP	[redacted]		

	B	C	D	E	F	G	H
1	***IWP Filters***						
164	COST ESTIMATE						
165	**Description**	**Quantity (English)**	**Unit (English)**	**Quantity (Metric)**	**Unit (Metric)**	**$/Unit**	**Total Cost**
166	SITEWORK:					(b)(4) 1-95 [redacted]	
167	Filters						
168	Excavation	717.28	CY	548.40	m3		
169	Imported Structural Backfill	393.42	CY	300.79	m3		
170	Native Backfill	50.30	CY	38.45	m3		
171	Haul Excess	666.98	CY	509.95	m3		
172	Blower Room:						
173	Excavation	11.95	CY	9.13	m3		
174	Imported Structural Backfill	18.96	CY	14.50	m3		
175	Native Backfill	1.19	CY	0.91	m3		
176	Haul Excess	10.76	CY	8.23	m3		
177	Electrical Room:						
178	Excavation	7.29	CY	5.57	m3		
179	Imported Structural Backfill	11.11	CY	8.50	m3		
180	Native Backfill	0.95	CY	0.73	m3		
181	Haul Excess	6.34	CY	4.84	m3		
182	Allowance for Misc Items	5%					
183	Subtotal						
184							
185	CONCRETE:						
186	Filters						
187	Foundation	349.90	CY	267.52	m3		
188	Blower Room						
189	Slab on Grade	5.33	CY	4.08	m3		
190	Electrical Room						
191	Slab on Grade	2.35	CY	1.79	m3		
192	Allowance for Misc Items	5%					
193	Subtotal						
194							
195	MASONRY:	High					
196	CMU Filter Building	4930.97	SF	458.10	m2		
197	Blower Room	144.00	SF	13.38	m2		
198	Electrical Room	63.33	SF	5.88	m2		
199	Subtotal	5,138.30					
200							
201	METALS:						
202	Canopy	0.00	SF	0.00	m2		
203	Allowance for Misc Items	10%					
204	Subtotal						
205							
206	EQUIPMENT:						
207	Filter Unit: Includes: tanks, internal and face piping for the filter system, a complete stainless steel media retention underdrain system for each filter, system control panel, air scour blowers, backwash influent pumps, and level transmitters for each filter.	2220.00	total SF				
208	Media						
209	Bottom Media - Sand (ES=1 UC=1.4)	13,320	CF	377.18	m3		
210	Middle Media - Sand (ES=0 UC=0)	0	CF	0.00	m3		
211	Top Media - GAC (ES=0 UC=0)	0	CF	0.00	m3		
212	Allowance for Misc Items	10%					
213	Subtotal						
214							
215	MECHANICAL:						
216	Pipe						
217	Filter Influent Header Pipe-FIH (30-inch , Buried , Steel , Cement Mortar , Fusion Bonded Epoxy)	45	LF	13.86	m		
218	Filter Effluent Header Pipe-FEH (30-inch , Encased , Steel , Cement Mortar , Fusion Bonded Epoxy)	45	LF	13.86	m		
219	Backwash Waste Pipe-BWW (16-inch , Encased , DI , Cement Mortar , Fusion Bonded Epoxy)	45	LF	13.86	m		
220	Elbows						
221	Filter Influent Header Pipe-FIH (30-inch , Steel)	0	EA				
222	Filter Effluent Header Pipe-FEH (30-inch , Steel)	0	EA				
223	Backwash Waste Pipe-BWW (16-inch , DI)	0	EA				
224	Tees						
225	Filter Influent Header Pipe-FIH (30-inch , Steel)	0	EA				
226	Filter Effluent Header Pipe-FEH (30-inch , Steel)	0	EA				
227	Backwash Waste Pipe-BWW (16-inch , DI)	0	EA				
228	Crosses						
229	Filter Influent Header Pipe-FIH (30-inch , Steel)	0	EA				
230	Filter Effluent Header Pipe-FEH (30-inch , Steel)	0	EA				
231	Backwash Waste Pipe-BWW (16-inch , DI)	0	EA				
232	Valves						
233	Filter Influent Header Pipe-FIH (30-inch ,V500 - BFV)	1	EA				
234	Filter Effluent Header Pipe-FEH (30-inch ,V500 - BFV)	1	EA				

	B	C	D	E	F	G	H
1	***IWP Filters***					(b)(4) 1-95 [redacted]	
235	Backwash Waste Pipe-BWW (16-inch ,V500 - BFV)	0	EA				
236	Allowance for Misc Items	5%					
237	Subtotal						
238							
239							
240	**USER DEFINED ESTIMATE ITEMS**	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**		
241	Item 1 Description	0.00		0.00			
242	Item 2 Description	0.00		0.00			
243	Item 3 Description	0.00		0.00			
244	Item 4 Description	0.00		0.00			
245	Item 5 Description	0.00		0.00			
246	Item 6 Description	0.00		0.00			
247	Item 7 Description	0.00		0.00			
248	Item 8 Description	0.00		0.00			
249	Item 9 Description	0.00		0.00			
250	Item 10 Description	0.00		0.00			
251	Item 11 Description	0.00		0.00			
252	Item 12 Description	0.00		0.00			
253	Item 13 Description	0.00		0.00			
254	Item 14 Description	0.00		0.00			
255	Item 15 Description	0.00		0.00			
256	Subtotal						
257							
258	Subtotal						
259							
260	ALLOWANCES:		User Over-write				
261	Finishes Allowance	2.00%		(b)(4) 1-95 [redacted]			
262	Mechanical Allowance	2.00%					
263	I&C Allowance	4.00%					
264	Electrical Allowance	4.00%					
265							
266	Facility Cost	12,787,200	GPD				
267	Facility Cost with Standard Additional Project Costs Added	12,787,200	GPD				
268	Facility Cost with Standard Additional Project Costs & Contractor Markups Added	12,787,200	GPD				
269	Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	12,787,200	GPD				
270	Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added (excluding ALL Additional Project Costs)	12,787,200	GPD				
271	Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	12,787,200	GPD				

IWP Pump Station on Concrete Slab

COST ESTIMATE

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:						
Pump Station:					(b)(4) 1-95	
Excavation	233.56	CY	178.57	m3		
Imported Structural Backfill	121.02	CY	92.52	m3		
Native Backfill	27.01	CY	20.65	m3		
Haul Excess	206.55	CY	157.92	m3		
Office:						
Excavation	0.00	CY	0.00	m3		
Imported Structural Backfill	0.00	CY	0.00	m3		
Native Backfill	0.00	CY	0.00	m3		
Haul Excess	0.00	CY	0.00	m3		
Surge Protection:						
Excavation	69.34	CY	53.01	m3		
Imported Structural Backfill	32.03	CY	24.49	m3		
Native Backfill	13.86	CY	10.60	m3		
Haul Excess	55.48	CY	42.41	m3		
Electrical Room:						
Excavation	57.66	CY	44.08	m3		
Imported Structural Backfill	25.99	CY	19.87	m3		
Native Backfill	12.49	CY	9.55	m3		
Haul Excess	45.17	CY	34.53	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Pump Station						
Foundation	98.19	CY	75.07	m3		
Support Walls	0.00	CY	0.00	m3		
Support Columns	0.00	CY	0.00	m3		
Pump Pad Epoxy	0.88	CY	0.68	m3		
Pump Pad Support	8.32	CY	6.36	m3		
Pipe Supports	1.02	CY	0.78	m3		
Mezzanine						
Elevated Slab	0.00	CY	0.00	m3		
Electrical Room						
Foundation	15.33	CY	11.72	m3		
Surge Protection						
Foundation	19.43	CY	14.86	m3		
Office						
Foundation	0.00	CY	0.00	m3		
Allowance for Misc Items	5%					
Subtotal						
MASONRY:	Moderate					
Pump Station Building	0.00	SF	0.00	m2		
Office Building	0.00	SF	0.00	m2		
Surge Building	0.00	SF	0.00	m2		
Electrical Room	206.94	SF	19.23	m2		
Subtotal	206.94					
METALS:						
Metal Guardrail with Pickets	0.00	LF	0.00	m		
Stairs = IF Mezzanine = 10 * 12/8	0.00	Risers				
Pump Removal Hatches	71.96	SF	6.69	m2		
Ladder	0.00	VLF	0.00	VLM		
Canopy	0.00	SF	0.00	m2		
Allowance for Misc Items	10%					
Subtotal						
EQUIPMENT:						
Pumps						
Active Pump # 1	75.00	HP	55.93	kW		
Active Pump # 2	0.00	HP	0.00	kW		
Active Pump # 3	0.00	HP	0.00	kW		
Active Pump # 4	0.00	HP	0.00	kW		
Active Pump # 5	0.00	HP	0.00	kW		
Active Pump # 6	0.00	HP	0.00	kW		

(b)(4) 1-95

IWP Pump Station on Concrete Slab				
Active Pump # 7	0.00	HP	0.00	kW
Active Pump # 8	0.00	HP	0.00	kW
Active Pump # 9	0.00	HP	0.00	kW
Active Pump # 10	0.00	HP	0.00	kW
Standby Pump	75.00	HP	55.93	kW
Allowance for Misc Items	10%			
Subtotal				
INSTRUMENTATION & CONTROLS:				
Instruments				
Isolation Valve Actuators	4.00	EA		
Control Valve Actuators	2.00	EA		
Level Indicator Transmitters	2.00	EA		
Level Swithces	2.00	EA		
Pressure Indicator Transmitters	3.00	EA		
Pressure Switches	4.00	EA		
Number of Analog I/O Counts	22.80	EA		
Number of Digital I/O Counts	46.80	EA		
Number of PLC's	2.00	EA		
I&C Conduit & Wire	0.00	LF	0.00	m
Allowance for Misc Items	10%			
Subtotal				
CONVEYING SYSTEMS				
Bridge Crane	0.00	EA		
Bridge Crane Rail	0.00	LF	0.00	m
Allowance for Misc Items	10%			
Subtotal				
MECHANICAL:				
Pipe:				
Suction Header Pipe (14-inch,SUC, Buried, Carbon Steel, Cement Mortar, Tape Coating)	28.36	LF	8.64	m
Suction Lateral Pipe (14-inch,SUC, Exposed, Carbon Steel, Cement Mortar, Paint)	16.33	LF	4.98	m
Discharge Lateral Pipe (14-inch,DIS, Exposed, Carbon Steel, Cement Mortar, Paint)	14.00	LF	4.27	m
Discharge Header Pipe (14-inch,DIS, Buried, Carbon Steel, Cement Mortar, Tape Coating)	28.36	LF	8.64	m
Elbows:				
Suction Header Pipe (14-inch)	4.00	EA		
Suction Lateral Pipe (14-inch)	4.00	EA		
Discharge Lateral Pipe (14-inch)	4.00	EA		
Discharge Header Pipe (14-inch)	4.00	EA		
Tees:				
Suction Header Pipe (14-inch)	0.00	EA		
Suction Lateral Pipe (14-inch)	0.00	EA		
Discharge Lateral Pipe (14-inch)	0.00	EA		
Discharge Header Pipe (14-inch)	0.00	EA		
Valves:				
Suction Header Isolation Valve (14-inch, BFV)	1.00	EA		
Suction Lateral Isolation Valve (14-inch, BFV)	2.00	EA		
Discharge Lateral Isolation Valve (14-inch, BFV)	2.00	EA		
Pump Control Valve (14-inch, Check Valve)	2.00	EA		
Discharge Header Isolation Valve (14-inch, BFV)	1.00	EA		
Air Release Vacuum Valves	6.00	EA		
Allowance for Misc Items	10%			
Subtotal				
ELECTRICAL:				
MCC's				
Sections	5.00	EA		
AFD's				
Active Pump # 1	75.00	HP	55.93	kW
Active Pump # 2	0.00	HP	0.00	kW
Active Pump # 3	0.00	HP	0.00	kW
Active Pump # 4	0.00	HP	0.00	kW
Active Pump # 5	0.00	HP	0.00	kW
Active Pump # 6	0.00	HP	0.00	kW
Active Pump # 7	0.00	HP	0.00	kW
Active Pump # 8	0.00	HP	0.00	kW
Active Pump # 9	0.00	HP	0.00	kW
Active Pump # 10	0.00	HP	0.00	kW
Standby Pump	75.00	HP	55.93	kW
Switchgear				

IWP Pump Station on Concrete Slab					(b)(4) 1-95 [redacted]	
Units	0.00	EA				
Electrical Conduit & Wire	0.00	LF	0.00	m		
Allowance for Misc Items	5%					
Subtotal						
USER DEFINED ESTIMATE ITEMS:	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**		
Item 1 Description	0.00		0.00			
Item 2 Description	0.00		0.00			
Item 3 Description	0.00		0.00			
Item 4 Description	0.00		0.00			
Item 5 Description	0.00		0.00			
Item 6 Description	0.00		0.00			
Item 7 Description	0.00		0.00			
Item 8 Description	0.00		0.00			
Item 9 Description	0.00		0.00			
Item 10 Description	0.00		0.00			
Item 11 Description	0.00		0.00			
Item 12 Description	0.00		0.00			
Item 13 Description	0.00		0.00			
Item 14 Description	0.00		0.00			
Item 15 Description	0.00		0.00			
Subtotal						
Subtotal						
ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]			
Finishes Allowance	2.00%					
I & C Allowance	2.00%					
Surge Allowance	5.00%					
Mechanical Allowance	2.00%					
Electrical Allowance	5.00%					
Facility Cost	150	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs Added	150	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	150	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	150	**Total Pump HP**				
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added ***(excluding ALL Additional Project Costs)***	150	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	150	**Total Pump HP**				

In-Plant Pump Station

COST ESTIMATE

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:					(b)(4) 1-95 [redacted]	
Excavation	328.69	CY	251.30	m3		
Imported Structural Backfill	89.33	CY	68.30	m3		
Native Backfill	70.15	CY	53.63	m3		
Haul Excess	258.54	CY	197.67	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Wet Well:						
Foundation	44.67	CY	34.15	m3		
Perimeter Walls	101.89	CY	77.90	m3		
Operating Floor:						
Elevated Slab (Including floor over Discharge Header Vault)	46.63	CY	35.65	m3		
Pump Pads	0.28	CY	0.21	m3		
Other Equipment Pads	1.00	CY	0.76	m3		
Discharge Pipe Vault:						
Slab on Grade	8.99	CY	6.87	m3		
Walls	10.88	CY	8.32	m3		
Allowance for Misc Items	5%					
Subtotal						
MASONRY:	Moderate					
CMU Building	1259.02	SF	116.97	m2		
Subtotal						
METALS:						
Checker Plate Over Intake Pipe Gate = (Diameter of Influent Pipe +2') * (2 Feet Wide) (sf)	5.33	SF	0.50	m2		
Checker Plate Over Discharge Pipe Header = ((Discharge Pipe Diameter * 2) * ("S" * Total Number of Pumps)	11.33	SF	1.05	m2		
Ladder	18.16	VLF	5.53	VLM		
Allowance for Misc Items	10%					
Subtotal						
THERMAL & MOISTURE PROTECTION:						
Wet Well Liner	0.00	SF	0.00	m2		
Allowance for Misc Items	10%					
Subtotal						
EQUIPMENT:						
Size of Sluice Gate (per side in inches)	8.00	in	203.20	mm		
Sluice Gate	1	EA				
Pumps:						
Active Pump # 1	4.58	HP	3.42	kW		
Active Pump # 2	4.58	HP	3.42	kW		
Active Pump # 3	0.00	HP	0.00	kW		
Active Pump # 4	0.00	HP	0.00	kW		
Active Pump # 5	0.00	HP	0.00	kW		
Active Pump # 6	0.00	HP	0.00	kW		
Active Pump # 7	0.00	HP	0.00	kW		
Active Pump # 8	0.00	HP	0.00	kW		
Active Pump # 9	0.00	HP	0.00	kW		
Active Pump # 10	0.00	HP	0.00	kW		
Standby Pump	4.58	HP	3.42	kW		
AFD's						
Active Pump # 1	4.58	HP	3.42	kW		
Active Pump # 2	4.58	HP	3.42	kW		
Active Pump # 3	0.00	HP	0.00	kW		
Active Pump # 4	0.00	HP	0.00	kW		
Active Pump # 5	0.00	HP	0.00	kW		
Active Pump # 6	0.00	HP	0.00	kW		
Active Pump # 7	0.00	HP	0.00	kW		
Active Pump # 8	0.00	HP	0.00	kW		
Active Pump # 9	0.00	HP	0.00	kW		
Active Pump # 10	0.00	HP	0.00	kW		
Standby Pump	4.58	HP	3.42	kW		
Allowance for Misc Items	10%					
Subtotal						

USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST
Item 1 Description	0.00		0.00		(b)(4) 1-95 [redacted]	

In-Plant Pump Station					(b)(4) 1-95 [redacted]	
Item 2 Description	0.00		0.00			
Item 3 Description	0.00		0.00			
Item 4 Description	0.00		0.00			
Item 5 Description	0.00		0.00			
Item 6 Description	0.00		0.00			
Item 7 Description	0.00		0.00			
Item 8 Description	0.00		0.00			
Item 9 Description	0.00		0.00			
Item 10 Description	0.00		0.00			
Item 11 Description	0.00		0.00			
Item 12 Description	0.00		0.00			
Item 13 Description	0.00		0.00			
Item 14 Description	0.00		0.00			
Item 15 Description	0.00		0.00			
Subtotal						
Subtotal						
ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]			
Finishes Allowance	2.00%					
I & C Allowance	8.00%					
Mechanical Allowance	25.00%					
Electrical Allowance	15.00%					
Facility Cost	14	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs Added	14	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	14	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	14	**Total Pump HP**				
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added ***(excluding ALL Additional Project Costs)***	14	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	14	**Total Pump HP**				

Emergency Generator

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:					(b)(4) 1-95 [redacted]	
Excavation	268.64	CY	#NAME?	m3		
Imported Structural Backfill	53.93	CY	#NAME?	m3		
Native Backfill	105.04	CY	#NAME?	m3		
Haul Excess	163.60	CY	#NAME?	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Foundation	55.47	CY	#NAME?	m3		
Allowance for Misc Items	5%					
Subtotal						
METALS:						
Access Platform	120	SF	11.15	m2		
Handrail	76	LF	0.00	m3		
Stairs	12	Risers				
Allowance for Misc Items	5%					
Subtotal						
SPECIAL CONSTRUCTION:						
Enclosure (Sound Attenuated Weather Proof (70-74 dbA at 23'))	1	EA	0.00	m2		
Allowance for Misc Items	5%					
Subtotal						
ELECTRICAL:						
Emergency Generator	750.00	KW				
(Diesel engine, including battery, charger, muffler, automatic transfer switch and day tank)						
Adder for Tier 4 Emissions Controls	22%					
Allowance for Misc Items	5%					
Subtotal						
USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)		
Item 1 Description	0.00		0.00			
Item 2 Description	0.00		0.00			
Item 3 Description	0.00		0.00			
Item 4 Description	0.00		0.00			
Item 5 Description	0.00		0.00			
Item 6 Description	0.00		0.00			
Item 7 Description	0.00		0.00			
Item 8 Description	0.00		0.00			
Item 9 Description	0.00		0.00			
Item 10 Description	0.00		0.00			
Item 11 Description	0.00		0.00			
Item 12 Description	0.00		0.00			
Item 13 Description	0.00		0.00			
Item 14 Description	0.00		0.00			
Item 15 Description	0.00		0.00			
Subtotal						
Subtotal						
ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]			
Finishes Allowance	2.00%					
I & C Allowance	4.00%					
Mechanical Allowance	1.00%					
Electrical Allowance	4.00%					
					Facility Cost Name	
Facility Cost	750	KW				
Facility Cost with Standard Additional Project Costs Added	750	KW				
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	750	KW				
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	750	KW				
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added ***(excluding ALL Additional Project Costs)***	750	KW				
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	750	KW				

Dry Chemical Storage & Feed - (Polymer)
Located in Stand Alone Chemical Building

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:						
Silo:						
Excavation	0.00	CY	0.00	m3	(b)(4) 1-95	
Imported Structural Backfill	0.00	CY	0.00	m3		
Native Backfill	0.00	CY	0.00	m3		
Haul Excess	0.00	CY	0.00	m3		
Supersack:						
Excavation	148.15	CY	#NAME?	m3		
Imported Structural Backfill	139.41	CY	#NAME?	m3		
Native Backfill	120.97	CY	#NAME?	m3		
Haul Excess	27.18	CY	#NAME?	m3		
Electrical Room:						
Excavation	21.15	CY	#NAME?	m3		
Imported Structural Backfill	17.48	CY	#NAME?	m3		
Native Backfill	3.59	CY	#NAME?	m3		
Haul Excess	17.56	CY	#NAME?	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Silo:						
Concrete Foundation	0.00	CY	0.00	m3		
Concrete Containment Walls	0.00	CY	#NAME?	m3		
Supersack:						
Slab on Grade:						
Containment Area	14.13	CY	#NAME?	m3		
Corridor	2.81	CY	#NAME?	m3		
Containment Walls	2.54	CY	#NAME?	m3		
Hopper Pads	1.05	CY	#NAME?	m3		
Metering Pump Pads	0.41	CY	#NAME?	m3		
Electrical Room:						
Slab on Grade	4.64	CY	#NAME?	m3		
Allowance for Misc Items	5%					
Subtotal						
MASONRY:	Moderate					
Silo Containment Area	0.00	SF	0.00	m2		
Containment Area	508.69	SF	#NAME?	m2		
Corridor	0.00	SF	#NAME?	m2		
Electrical Room	125.33	SF	#NAME?	m2		
Subtotal	634.03					
METALS:						
Metal Stairway	2	EA				
Grating	1	EA				
Allowance for Misc Items	10%					
Subtotal						
EQUIPMENT:						
Silo(s)	0	EA				
Hopper Feeder System	1	EA				
Transfer Pump- Application 1	2	EA				
Transfer Pump- Application 2	0	EA				
Transfer Pump- Application 3	0	EA				
Allowance for Misc Items	10%					
Subtotal						
MECHANICAL:						
Pipe						
Chemical Transfer Pump Suction Header Piping-LCSH (2.5-inch, Exposed, PVC)	42.75	LF	#NAME?	m		
Chemical Transfer Pump Discharge Header Piping-LCDH (1.5-inch, Exposed, FRP)	42.75	LF	#NAME?	m		
Plant Water Pipe-PW (1-inch, Exposed, PVC)	19.98	LF	#NAME?	m		
Elbows						
Chemical Transfer Pump Suction Header Piping-LCSH (2.5-inch, Exposed, PVC)	8	EA				
Chemical Transfer Pump Discharge Header Piping-LCDH (1.5-inch, Exposed, FRP)	12	EA				
Plant Water Pipe-PW (1-inch, Exposed, PVC)	2	EA				
Tees						
Chemical Transfer Pump Suction Header Piping-LCSH (2.5-inch, Exposed, PVC)	2	EA				
Chemical Transfer Pump Discharge Header Piping-LCDH (1.5-inch, Exposed, FRP)	1	EA				
Plant Water Pipe-PW (1-inch, Exposed, PVC)	0	EA				
Valves						

Dry Chemical Storage & Feed - (Polymer) Located in Stand Alone Chemical Building						
Chemical Transfer Pump Suction Header Piping-LCSH (2.5-inch, Exposed, PVC, V-902, Diaphragm)	2	EA			(b)(4) 1-95 [redacted]	
Chemical Transfer Pump Discharge Header Piping-LCDH (1.5-inch, Exposed, FRP, V-902, Diaphragm)	2	EA				
Plant Water Pipe-PW (1-inch, Exposed, PVC, V-902, Diaphragm)	1	EA				
Allowance for Misc Items	10%					
Subtotal						
ELECTRICAL:						
# MCC Sections	5	#				
Switchgear	0	EA				
Adjustable Frequency Drives						
Transfer Pumps - Aplication #1	0	EA				
Transfer Pumps - Aplication #2	0	EA				
Transfer Pumps - Aplication #3	0	EA				
Hoppers	0	EA				
Electrical Conduit & Wire	72.00	LF	#NAME?	m		
Allowance for Misc Items	10%					
Subtotal						
USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)		
Item 1 Description	0.00		0.00			
Item 2 Description	0.00		0.00			
Item 3 Description	0.00		0.00			
Item 4 Description	0.00		0.00			
Item 5 Description	0.00		0.00			
Item 6 Description	0.00		0.00			
Item 7 Description	0.00		0.00			
Item 8 Description	0.00		0.00			
Item 9 Description	0.00		0.00			
Item 10 Description	0.00		0.00			
Item 11 Description	0.00		0.00			
Item 12 Description	0.00		0.00			
Item 13 Description	0.00		0.00			
Item 14 Description	0.00		0.00			
Item 15 Description	0.00		0.00			
Subtotal						
Subtotal						
ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]			
Finishes Allowance	2.00%					
I & C Allowance	2.00%					
Mechanical Allowance	4.00%					
Electrical Allowance	2.00%					
					Facility Cost Name	
Facility Cost	634	Building SF			CFDFC01	
Facility Cost with Standard Additional Project Costs Added	634	Building SF			CFDFC02	
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	634	Building SF			CFDFC03	
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	634	Building SF			CFDFC04	
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added (excluding ALL Additional Project Costs)	634	Building SF			CFDFC05	
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	634	Building SF			CFDFC06	

Liquid Chemical Storage & Feed - (Hydrochloric Acid)
Located in Stand Alone Chemical Building

(b)(4) 1-95

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:						
Excavation	59.18	CY	#NAME?	m3		
Imported Structural Backfill	53.78	CY	#NAME?	m3		
Native Backfill	5.78	CY	#NAME?	m3		
Haul Excess	53.40	CY	#NAME?	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Slab on Grade	22.92	CY	#NAME?	m3		
Containment Walls	3.67	CY	#NAME?	m3		
Bulk Tank Pads	0.00	CY	0.00	m3		
Day Tank Pads	0.00	CY	#NAME?	m3		
Transfer Pump Pads	0.00	CY	0.00	m3		
Metering Pump Pads	1.33	CY	1.02	m3		
Corridor						
Slab on Grade	0.00	CY	#NAME?	m3		
Electrical Room						
Slab on Grade	3.04	CY	2.32	m3		
Allowance for Misc Items	5%					
Subtotal						
	Moderate					
MASONRY:						
CMU Building	726.00	SF	#NAME?	m2		
Subtotal						
METALS:						
Canopy	0.00	SF	#NAME?	m2		
Metal Stairway	1	EA				
Grating	1	EA				
Allowance for Misc Items	10%					
Subtotal						
EQUIPMENT:						
Bulk Tank	0	EA				
Day Tank	0	EA				
Transfer Pump	0	EA				
Metering Pump	2	EA				
Allowance for Misc Items	10%					
Subtotal						
INSTRUMENTS & CONTROLS:						
Instruments						
Chemical Tank Radar Level Transmitters	0	EA				
Chemical Tank Beacons	0	EA				
Day Tank Differential Pressure Transmitter	0	EA				
Drum or Tote Weigh Scale	3	EA				
Metering Pump Discharge Pressure Switch	2	EA				
Magmeter	1	EA				
Sump Pump Float Switch	1	EA				
Eyewash	1	EA				
Number of Analog I/O Counts	8	EA				
Number of Digital I/O Counts	15	EA				
Number of Local Panels	1	EA				
Number of PLCs	1	EA				
I&C Conduit & Wire	224.00	LF	#NAME?	m		
Allowance for Misc Items	10%					
Subtotal						
MECHANICAL:						
Pipe						
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0.00	LF	#NAME?	m		
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0.00	LF	#NAME?	m		
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	51.00	LF	#NAME?	m		
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	51.00	LF	#NAME?	m		
Elbows						
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA				
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA				
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	8	EA				
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	8	EA				
Tees						
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA				
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA				
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA				
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA				
End Caps						
Chemical Transfer Pump Suction Header Piping-CTSH (1-inch, Exposed, PVC)	0	EA				
Chemical Transfer Pump Discharge Header Piping-CTDH (1-inch, Exposed, PVC)	0	EA				
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA				

Liquid Chemical Storage & Feed - (Hydrochloric Acid)						
Located in Stand Alone Chemical Building						
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC)	2	EA			(b)(4) 1-95 [redacted]	
Valves						
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA				
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	0	EA				
Chemical Metering Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA				
Chemical Metering Pump Discharge Header Piping-LCDH (1-inch, Exposed, PVC, V-902, Diaphragm)	4	EA				
Allowance for Misc Items	10%					
Subtotal						
ELECTRICAL:						
# MCC Sections	5	#				
Switchgear	0	EA				
Adjustable Frequency Drives						
Metering Pumps	0	EA				
User Defined Item #1	0	EA				
User Defined Item #2	0	EA				
User Defined Item #3	0	EA				
Electrical Conduit & Wire	112.00	LF	#NAME?	m		
Allowance for Misc Items	10%					
Subtotal						
USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)		
Item 1 Description	0.00					
Item 2 Description	0.00					
Item 3 Description	0.00					
Item 4 Description	0.00					
Item 5 Description	0.00					
Item 6 Description	0.00					
Item 7 Description	0.00					
Item 8 Description	0.00					
Item 9 Description	0.00					
Item 10 Description	0.00					
Item 11 Description	0.00					
Item 12 Description	0.00					
Item 13 Description	0.00					
Item 14 Description	0.00					
Item 15 Description	0.00					
Subtotal						
Subtotal						
ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]			
Finishes Allowance	2.00%					
I & C Allowance	2.00%					
Mechanical Allowance	4.00%					
Electrical Allowance	2.00%					
					Facility Cost Name	
Facility Cost	726	Building SF			CFLFC01	
Facility Cost with Standard Additional Project Costs Added	726	Building SF			CFLFC02	
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	726	Building SF			CFLFC03	
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	726	Building SF			CFLFC04	
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added (excluding ALL Additional Project Costs)	726	Building SF			CFLFC05	
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	726	Building SF			CFLFC06	

Dry Chemical Storage & Feed - (Sodium Hydrosulfide)
Located in Stand Alone Chemical Building

COST ESTIMATE

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:						
Silo:						
Excavation	0.00	CY	0.00	m3	(b)(4) 1-95	
Imported Structural Backfill	0.00	CY	0.00	m3		
Native Backfill	0.00	CY	0.00	m3		
Haul Excess	0.00	CY	0.00	m3		
Supersack:						
Excavation	111.71	CY	#NAME?	m3		
Imported Structural Backfill	103.84	CY	#NAME?	m3		
Native Backfill	104.47	CY	#NAME?	m3		
Haul Excess	7.24	CY	#NAME?	m3		
Electrical Room:						
Excavation	0.00	CY	#NAME?	m3		
Imported Structural Backfill	0.00	CY	#NAME?	m3		
Native Backfill	0.00	CY	#NAME?	m3		
Haul Excess	0.00	CY	#NAME?	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Silo:						
Concrete Foundation	0.00	CY	0.00	m3		
Concrete Containment Walls	0.00	CY	#NAME?	m3		
Supersack:						
Slab on Grade:						
Containment Area	14.02	CY	#NAME?	m3		
Corridor	0.00	CY	#NAME?	m3		
Containment Walls	2.27	CY	#NAME?	m3		
Hopper Pads	1.05	CY	#NAME?	m3		
Metering Pump Pads	0.04	CY	#NAME?	m3		
Electrical Room:						
Slab on Grade	0.00	CY	#NAME?	m3		
Allowance for Misc Items	5%					
Subtotal						
MASONRY:	Moderate					
Silo Containment Area	0.00	SF	0.00	m2		
Containment Area	504.89	SF	#NAME?	m2		
Corridor	0.00	SF	#NAME?	m2		
Electrical Room	0.00	SF	#NAME?	m2		
Subtotal	504.89					
METALS:						
Metal Stairway	2	EA				
Grating	1	EA				
Allowance for Misc Items	10%					
Subtotal						
EQUIPMENT:						
Silo(s)	0	EA				
Hopper Feeder System	1	EA				
Transfer Pump- Application 1	2	EA				
Transfer Pump- Application 2	0	EA				
Transfer Pump- Application 3	0	EA				
Allowance for Misc Items	10%					
Subtotal						
MECHANICAL:						
Pipe						
Chemical Transfer Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	43.00	LF	#NAME?	m		
Chemical Transfer Pump Discharge Header Piping-LCDH (1-inch, Exposed, FRP)	43.00	LF	#NAME?	m		
Plant Water Pipe-PW (1-inch, Exposed, PVC)	19.98	LF	#NAME?	m		
Elbows						
Chemical Transfer Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	8	EA				
Chemical Transfer Pump Discharge Header Piping-LCDH (1-inch, Exposed, FRP)	12	EA				
Plant Water Pipe-PW (1-inch, Exposed, PVC)	2	EA				
Tees						
Chemical Transfer Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC)	2	EA				
Chemical Transfer Pump Discharge Header Piping-LCDH (1-inch, Exposed, FRP)	1	EA				
Plant Water Pipe-PW (1-inch, Exposed, PVC)	0	EA				
Valves						

Dry Chemical Storage & Feed - (Sodium Hydrosulfide)						
Located in Stand Alone Chemical Building						
Chemical Transfer Pump Suction Header Piping-LCSH (1-inch, Exposed, PVC, V-902, Diaphragm)	2	EA			(b)(4) 1-95 [redacted]	
Chemical Transfer Pump Discharge Header Piping-LCDH (1-inch, Exposed, FRP, V-902, Diaphragm)	2	EA				
Plant Water Pipe-PW (1-inch, Exposed, PVC, V-902, Diaphragm)	1	EA				
Allowance for Misc Items	10%					
Subtotal						
ELECTRICAL:						
# MCC Sections	5	#				
Switchgear	0	EA				
Adjustable Frequency Drives						
Transfer Pumps - Aplication #1	0	EA				
Transfer Pumps - Aplication #2	0	EA				
Transfer Pumps - Aplication #3	0	EA				
Hoppers	0	EA				
Electrical Conduit & Wire	20.00	LF	#NAME?	m		
Allowance for Misc Items	10%					
Subtotal						
USER DEFINED ESTIMATE ITEMS:	**QUANT (ENGLISH)**	**UNIT (ENGLISH)**	**QUANT (METRIC)**	**UNIT (METRIC)**		
Item 1 Description	0.00		0.00			
Item 2 Description	0.00		0.00			
Item 3 Description	0.00		0.00			
Item 4 Description	0.00		0.00			
Item 5 Description	0.00		0.00			
Item 6 Description	0.00		0.00			
Item 7 Description	0.00		0.00			
Item 8 Description	0.00		0.00			
Item 9 Description	0.00		0.00			
Item 10 Description	0.00		0.00			
Item 11 Description	0.00		0.00			
Item 12 Description	0.00		0.00			
Item 13 Description	0.00		0.00			
Item 14 Description	0.00		0.00			
Item 15 Description	0.00		0.00			
Subtotal						
Subtotal						
ALLOWANCES:		User Over-write	(b)(4) 1-95 [redacted]			
Finishes Allowance	2.00%					
I & C Allowance	2.00%					
Mechanical Allowance	4.00%					
Electrical Allowance	2.00%					
					Facility Cost Name	
Facility Cost	505	**Building SF**			CFDFC01	
Facility Cost with Standard Additional Project Costs Added	505	**Building SF**			CFDFC02	
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	505	**Building SF**			CFDFC03	
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	505	**Building SF**			CFDFC04	
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added (excluding ALL Additional Project Costs)	505	**Building SF**			CFDFC05	
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	505	**Building SF**			CFDFC06	

In-Plant Pump Station

COST ESTIMATE

Description	Quantity (English)	Unit (English)	Quantity (Metric)	Unit (Metric)	$/Unit	Total Cost
SITEWORK:					(b)(4) 1-95 [redacted]	
Excavation	372.90	CY	285.10	m3		
Imported Structural Backfill	105.23	CY	80.46	m3		
Native Backfill	69.87	CY	53.42	m3		
Haul Excess	303.04	CY	231.69	m3		
Allowance for Misc Items	5%					
Subtotal						
CONCRETE:						
Wet Well:						
Foundation	52.62	CY	40.23	m3		
Perimeter Walls	98.23	CY	75.10	m3		
Operating Floor:						
Elevated Slab (Including floor over Discharge Header Vault)	61.06	CY	46.68	m3		
Pump Pads	1.97	CY	1.51	m3		
Other Equipment Pads	1.00	CY	0.76	m3		
Discharge Pipe Vault:						
Slab on Grade	16.04	CY	12.26	m3		
Walls	17.80	CY	13.61	m3		
Allowance for Misc Items	5%					
Subtotal						
MASONRY:	Moderate					
CMU Building	1648.65	SF	153.16	m2		
Subtotal						
METALS:						
Checker Plate Over Intake Pipe Gate = (Diameter of Influent Pipe +2') * (2 Feet Wide) (sf)	9.00	SF	0.84	m2		
Checker Plate Over Discharge Pipe Header = ((Discharge Pipe Diameter * 2) * ("S" * Total Number of Pumps)	45.33	SF	4.21	m2		
Ladder	17.57	VLF	5.36	VLM		
Allowance for Misc Items	10%					
Subtotal						
THERMAL & MOISTURE PROTECTION:						
Wet Well Liner	0.00	SF	0.00	m2		
Allowance for Misc Items	10%					
Subtotal						
EQUIPMENT:						
Size of Sluice Gate (per side in inches)	30.00	in	762.00	mm		
Sluice Gate	1	EA				
Pumps:						
Active Pump # 1	51.29	HP	38.25	kW		
Active Pump # 2	51.29	HP	38.25	kW		
Active Pump # 3	51.29	HP	38.25	kW		
Active Pump # 4	0.00	HP	0.00	kW		
Active Pump # 5	0.00	HP	0.00	kW		
Active Pump # 6	0.00	HP	0.00	kW		
Active Pump # 7	0.00	HP	0.00	kW		
Active Pump # 8	0.00	HP	0.00	kW		
Active Pump # 9	0.00	HP	0.00	kW		
Active Pump # 10	0.00	HP	0.00	kW		
Standby Pump	51.29	HP	38.25	kW		
AFD's						
Active Pump # 1	51.29	HP	38.25	kW		
Active Pump # 2	51.29	HP	38.25	kW		
Active Pump # 3	51.29	HP	38.25	kW		
Active Pump # 4	0.00	HP	0.00	kW		
Active Pump # 5	0.00	HP	0.00	kW		
Active Pump # 6	0.00	HP	0.00	kW		
Active Pump # 7	0.00	HP	0.00	kW		
Active Pump # 8	0.00	HP	0.00	kW		
Active Pump # 9	0.00	HP	0.00	kW		
Active Pump # 10	0.00	HP	0.00	kW		
Standby Pump	51.29	HP	38.25	kW		
Allowance for Misc Items	10%					
Subtotal						

USER DEFINED ESTIMATE ITEMS:	QUANT (ENGLISH)	UNIT (ENGLISH)	QUANT (METRIC)	UNIT (METRIC)	$/UNIT	TOTAL COST
Item 1 Description	0.00		0.00		(b)(4) 1-95 [redacted]	

In-Plant Pump Station					(b)(4) 1-95 [redacted]	
Item 2 Description	0.00		0.00			
Item 3 Description	0.00		0.00			
Item 4 Description	0.00		0.00			
Item 5 Description	0.00		0.00			
Item 6 Description	0.00		0.00			
Item 7 Description	0.00		0.00			
Item 8 Description	0.00		0.00			
Item 9 Description	0.00		0.00			
Item 10 Description	0.00		0.00			
Item 11 Description	0.00		0.00			
Item 12 Description	0.00		0.00			
Item 13 Description	0.00		0.00			
Item 14 Description	0.00		0.00			
Item 15 Description	0.00		0.00			
Subtotal						
Subtotal						
ALLOWANCES:		**User Over-write**	(b)(4) 1-95 [redacted]			
Finishes Allowance	2.00%					
I & C Allowance	8.00%					
Mechanical Allowance	25.00%	15.00%				
Electrical Allowance	15.00%	10.00%				
Facility Cost	**205**	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs Added	**205**	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs & Contractor Markups Added	**205**	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs, Contractor Markups & Escalation Added	**205**	**Total Pump HP**				
Facility Cost, Contractor Markups, Escalation Added & Location Adjustment Factor Added *(excluding ALL Additional Project Costs)*	**205**	**Total Pump HP**				
Facility Cost with Standard Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**205**	**Total Pump HP**				

BUNKER HILL CIA			**DATE:**	**5/29/2013**	
CTP DEFINITION			**PROJECT NO.:**	**382081.RD.03.35.05**	
CPES COST SUPPORT ITEMS			**ESTIMATE BY:**	**C. Moore**	
ORDER OF MAGNITUDE; CLASS 4			**REVIEW BY:**		

DESCRIPTION	QTY	UNIT	TOTAL UNIT COST	TOTAL COST	COMMENTS
CTP Effluent Discharge Pipe & Pumps			(b)(4) 1-95 [redacted]		
24" Pipeline	**1**	**LS**			
HDPE Pipe, 24" Dia, DR21	3,300	LF			RS Means 33111335
Trench Excavation	4,736	CY			
Bed & Zone	1,755	CY			Crushed Rock material per The Guide
Native Backfill over B&Z	2,597	CY			
Waste pond sludge and sediments	2,139	CY			
Hauling, 18 CY Truck & Trailer	2,139	CY			3 miles @ 25 mile/hr + loading, dump, wait
Truck Loading	2,139	CY			
Spread and compact waste at site	2,139	CY			
SUBTOTAL					
OVERHEAD & PROFIT	**0.0%**				**ncluded on CPES**
SUBTOTAL					
CONTINGENCY	**0.0%**				**ncluded on CPES**
CONSTRUCTION TOTAL					
SALES TAX (IDAHO), MATERIAL ONLY	**6.0%**				**ncluded on CPES**
TOTAL (Rounded)					
ACCURACY RANGE (Rounded)	**40.0%**				**ncluded on CPES**
	-20.0%				**ncluded on CPES**

NOTE: The above cost opinion is in May 2013 dollars and does not include future escalation, right of way, construction management, legal, administrative, financial or O&M costs. The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

BUNKER HILL CIA
SEEPAGE COLLECTION TRENCH
ALT 3: 12 wells, long wall around SPA
Class 4 Estimate

DATE: 6/26/2013
PROJECT NO.:
ESTIMATE BY: C. Moore/K. Dawson
REVIEW BY: P. Bredehoeft

DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR/EQUIPMENT UNIT HOURS	LABOR/EQUIPMENT CREW RATE	LABOR/EQUIPMENT UNIT COST	LABOR/EQUIPMENT TOTAL	EXTENDED COST	TOTAL UNIT COST	TOTAL COST	COMMENTS
Mobilization/General Conditions	1	LS	(b)(4) 1-95 [redacted]									
Mobilization/General Conditions/Bonds	1	LS										Use 10% of remaining construction costs for small contract
Erosion Control/Misc Site Work	1	LS										
Dust Control (Water Trucks)	4	MO										2 water trucks onsite during construction
Silt Fence	17,000	LF										RS Means 31251416
Tire Wash/Decon Station	4	MO										HD-10 super soaker wheel wash, generator, hopper. Does not include water usage & treatment.
Worker Shower/Decon Station	1	LS										Set up and remove portable shower system, water usage costs not included
Field Fencing, (Hog wire), posts 4' OC, 2" mesh, 6' high	16,000	LF										RS Means 323126100100
Header Pipe	5,400	LF										
14" HDPE	5,400	LF										RS Means 331113350800
Detectable Tape	5,400	LF										RS Means 33052610
Excavate Trench	6,800	CY										Based on 600 cy/day
Pipe Bed & Zone Material	2,186	CY										Material Cost per The Guide Eastern WA; Based on 400 cy/day
Native Backfill	4,400	CY										Based on 600 cy/day
Waste Hauling	2,400	CY										5 miles @ 25 mile/hr + decon time + loading, dump, wa
Truck Loading	2,400	CY										
Spread and compact waste at site	2,400	CY										
Shoring Allowance	2,000	LF										Mechanical Shoring Allowance (mix of slide rail, hydralically jacked steel sheets)
Rototill in 5% Bentonite into 12" layer beneath clean cover	540	TON										Bentonite pricing per discussion with Geotech and conceptual cost per Wyo-Ben, Inc
Place 6" Clean Soil Cover, 30' wide	3,000	CY										Based on 600 cy/day
Feeder Power Line	5,400	LF										
Feeder Power Line	5,400	LF										Allowance for underground power along Header Pipe
Maintenance Road for Header Pipe	8,000	LF										
Road grading	10,667	SY										RS Means 31221610
Separation Geotextile	10,667	SY										RS Means 32112323
Crushed Surface Base Course, 9" depth	2,667	CY										Material Cost per The Guide Eastern WA; Based on 800 cy/day
Force Main	5,500	LF										
14" HDPE	5,500	LF										RS Means 331113350800
Testing	5,500	LF										Testing Allowance
Detectable Tape	5,500	LF										RS Means 33052610
Excavate Trench	4,221	CY										Based on 600 cy/day
Pipe Bed & Zone Material	1,502	CY										Material Cost per The Guide Eastern WA; Based on 400 cy/day
CLSM Bed & Zone at Utility Crossing	55	CY										Chute place in trench, Material cost per The Guide; Allowance of 10 crossings 20 ft long
Native Backfill	1,546	CY										Based on 600 cy/day
Imported Backfill	955	CY										Based on 600 cy/day; Pit run materials
Waste Hauling	2,675	CY										5 miles @ 25 mile/hr + decon time + loading, dump, wa
Truck Loading	2,675	CY										
Spread and compact waste at site	2,675	CY										
Place 6" Clean Soil Cover, 30' wide	1,889	CY										Based on 600 cy/day
Shoring Allowance	2,100	LF										Mechanical Shoring Allowance (mix of slide rail, hydralically jacked steel sheets)
ACP Demo	1,983	SY										RS Means 02411317
ACP Sawcutting	4,200	LF										Sub contractor
Separation Geotextile	1,983	SY										RS Means 32112323
Crushed Surface Top Course, 6" depth	331	CY										Material Cost per The Guide Eastern WA; Based on
Crushed Surface Base Course, 12" depth	661	CY										Material Cost per The Guide Eastern WA; Based on
ACP Patching, 6" Depth	678	TON										Patching pricing; Sub contractor, price incl tax
Pig/Launcher Reciever	2	EA										
Pig/Launcher Reciever	2	EA										See Pig cost backup sheet
Testing	1	LS										Testing Allowance
Pre-Cast Utility Vault for Pig (8'x14'x7')	2	EA										RS Means 33051613
Additional Booster Pumping for Pig												
CD100M Dri Prime Skid Mounted, 450 gpm pump	1	EA										Keep in storage, bring out to site when need for pigging on trailer and hook up to water supply. Pricing per Godwin GSA price sheet.
Pump Enclosure (pre-fab metal on concrete slab)	1	LS										Allowance
Pipe to Additional Water Source for Pigging												
10" HDPE	1,000	LF										RS Means 331113350400

BUNKER HILL CIA
SEEPAGE COLLECTION TRENCH
ALT 3: 12 wells, long wall around SPA
Class 4 Estimate

DATE: 6/26/2013
PROJECT NO.:
ESTIMATE BY: C. Moore/K. Dawson
REVIEW BY: P. Bredehoeft

DESCRIPTION	QTY	UNIT	MATERIAL UNIT COST	MATERIAL TOTAL	LABOR/EQUIPMENT UNIT HOURS	LABOR/EQUIPMENT CREW RATE	LABOR/EQUIPMENT UNIT COST	LABOR/EQUIPMENT TOTAL	EXTENDED COST	TOTAL UNIT COST	TOTAL COST	COMMENTS
Butterfly Valve	1	EA	(b)(4) 1-95 [redacted]									CH2M Database
Pump Hookup	1	LS										Allowance
Detectable Tape	1,000	LF										RS Means 33052610
Excavate Trench	658	CY										Based on 600 cy/day
Pipe Bed & Zone Material	239	CY										Material Cost per The Guide Eastern WA; Based on 400 cy/day
Native Backfill	399	CY										Based on 600 cy/day
Waste Hauling	259	CY										5 miles @ 25 mile/hr + decon time + loading, dump, wa
Truck Loading	259	CY										
Spread and compact waste at site	259	CY										
Cut Off Wall	**8,800**	**LF**										
Slurry Wall	264,000	SF										e-mail quote of $6.5/SF for 2' wide wall, extrapolated for 2.5' wide wall; Split 50/50 Material & Labor
Quality Testing of Slurry Wall	1	LS										5% allowance per Geotech
Temp Bypass of 8" water & 36" gravity sewer												
Sump Pump Drain Pipes	200	LF										8"Diam; hoses install when needed
System Pump Rental	2	WK										2 diesel pumps @ 1500 gpm; 1 pump operating 7 day 24 hr/day, 2nd standby
Pump Operator/Maintenance	2	WK										2 hrs per shift, 6 hrs per day
Overflow Improvement Area, 36" depth x 25' wide, gravel	24,444	CY										Material Cost per The Guide Eastern WA; Based on 800 cy/day
Wells	**12**	**EA**										
Drill well including, drilling casing, surface seal, drive shoe, well permit, mob, cuttings & water containment	12	VLF										Based on H2O Well Drilling Quote for project; Split 50/50 between material & labor
Pump Vault w/ freeze protection	12	EA										Allowance
Temporary Development water disposal system	36	DAY										Collect water in poly tank and siphon to water trucks to take to palnt for treatment, 2 trucks during operation
Connection Piping & Backflow Preventor	12	EA										5' length 6" Pipe; RS Means 22111942572(
Pump, 200 gpm, Grundfos 150S100-5	12	EA										Quote per Jerome Gogue at INWUSA 5/21/13
Power Cord	12	EA										Quote per Jerome Gogue at INWUSA 5/21/13
SST Support Cables	12	EA										Quote per Jerome Gogue at INWUSA 5/21/13
Clip & Thimble Kit	12	EA										Quote per Jerome Gogue at INWUSA 5/21/13
Control Panel	12	EA										Allowance
Electrical Service from Feeder Power	12	EA										8 hour allowance
Varible Speed Drive	12	EA										Quote per Jerome Gogue at INWUSA 5/21/13
4-20mA Analog sensor w/ cable	12	EA										
Treatment Plant Upgrade Cost	**1**	**LS**										
SUBTOTAL												Excludes Treatment Plant Upgrade
CONTINGENCY	**0.0%**											To be added in total project cost roll up
CONSTRUCTION TOTAL												
SALES TAX (IDAHO), MATERIAL ONLY	**6.0%**											
CAPITAL CONSTRUCTION TOTAL (Rounded)												

Notes:
1. Costs do NOT include any OH&P.
2. Costs do NOT include any Mob/Bonds/Ins/General Conditions.
3. Costs do NOT include any Contingency.
4. Costs do NOT include any Escalation.
5. Costs DO include any sales tax on materials.

NOTE: The above cost opinion is in May 2013 dollars and does not include future escalation, right of way, construction management, legal, administrative, financial or O&M costs. The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

TYPE 1 TRENCHING										
Header Pipe Open Cut										
Proj No:				Slope						
Item:	14	" Pipe - HDPE								
								Pipe X-section =	1.069	sq. ft.
		4	ft cover					Width =	3.17	ft.
Pipe Diameter, Nom		14.00	inches	P				Zone Depth =	2.17	ft.
Depth		5.7	feet	I Zone				Zone + Base Depth=	2.67	ft.
Length		5,400.0	feet	T						
Slope: 1 Vert. to		0.50	Horiz.	Base						
				Width						
- Calculated Volumes:				Top Width =		8.8				
Trench Excavation	=	6,800.00	cu yd							
Bed + Zone fill	=	2,186.20	cu yd	- Constants:	--	---				
Zone Only Fill	=	1,869.53	cu yd	Base Depth =		6	in.			
Bed Only Fill	=	316.67	cu yd	Zone Depth =	D+	12	in.			
Backfill Above Zone =		4,400.00	cu yd	Min. Width =		36	in.			
Waste if Import Bed, Zone =		2,400.00	cu yd	Width =	D+	24	in.			
Waste if Native Bed, Zone =		213.80	cu yd	Pit Depth =		0	ft.			
Surface Restoration Area =		17,300.00	sq yd	<= Wid+/Side		10	ft.			

TYPE 1 TRENCHING										
Force Main Lay Back Sides from Bottom										
Proj No:				Slope						
Item:	14	" Pipe - HDPE								
								Pipe X-section =	1.069	sq. ft.
		4	ft cover					Width =	3.17	ft.
Pipe Diameter, Nom		14.00	inches	P				Zone Depth =	2.17	ft.
Depth		5.7	feet	I Zone				Zone + Base Depth=	2.67	ft.
Length		3,400.0	feet	T						
Slope: 1 Vert. to		1.00	Horiz.	Base						
				Width						
- Calculated Volumes:				Top Width =		6.5				
Trench Excavation	=	2,609.47	cu yd							
Bed + Zone fill	=	928.76	cu yd	- Constants:	--	---				
Zone Only Fill	=	729.38	cu yd	Base Depth =		6	in.			
Bed Only Fill	=	199.38	cu yd	Zone Depth =	D+	12	in.			
Backfill Above Zone =		1,546.09	cu yd	Min. Width =		36	in.			
Waste if Import Bed, Zone =		1,063.37	cu yd	Width =	D+	24	in.			
Waste if Native Bed, Zone =		134.62	cu yd	Pit Depth =		4	ft.			
Surface Restoration Area =		3,211.11	sq yd	<= Wid+/Side		1	ft.			

TYPE 1 TRENCHING										
Force Main Trench Box										
Proj No:				Slope						
Item:	14	" Pipe - HDPE								
								Pipe X-section =	1.069	sq. ft.
		4	ft cover					Width =	3.17	ft.
Pipe Diameter, Nom		14.00	inches	P				Zone Depth =	2.17	ft.
Depth		5.7	feet	I Zone				Zone + Base Depth=	2.67	ft.
Length		2,100.0	feet	T						
Slope: 1 Vert. to		1.00	Horiz.	Base						
				Width						
- Calculated Volumes:				Top Width =		6.5				
Trench Excavation	=	1,611.73	cu yd							
Bed + Zone fill	=	573.64	cu yd	- Constants:	--	---				
Zone Only Fill	=	450.50	cu yd	Base Depth =		6	in.			
Bed Only Fill	=	123.15	cu yd	Zone Depth =	D+	12	in.			
Backfill Above Zone =		954.94	cu yd	Min. Width =		36	in.			
Waste if Import Bed, Zone =		656.79	cu yd	Width =	D+	24	in.			
Waste if Native Bed, Zone =		83.15	cu yd	Pit Depth =		4	ft.			
Surface Restoration Area =		1,983.33	sq yd	<= Wid+/Side		1	ft.			

TYPE 1 TRENCHING										
Pigging Water Source										
Proj No:				Slope						
Item:	10	" Pipe - HDPE								
								Pipe X-section =	0.545	sq. ft.
		4	ft cover					Width =	3.00	ft.
Pipe Diameter, Nom		10.00	inches	P				Zone Depth =	1.83	ft.
Depth		5.3	feet	I Zone				Zone + Base Depth=	2.33	ft.
Length		1,000.0	feet	T						
Slope: 1 Vert. to		1.00	Horiz.	Base						
				Width						
- Calculated Volumes:				Top Width =		5.7				
Trench Excavation	=	658.44	cu yd							
Bed + Zone fill	=	239.06	cu yd	- Constants:	--	---				
Zone Only Fill	=	183.50	cu yd	Base Depth =		6	in.			
Bed Only Fill	=	55.56	cu yd	Zone Depth =	D+	12	in.			
Backfill Above Zone =		399.18	cu yd	Min. Width =		36	in.			
Waste if Import Bed, Zone =		259.26	cu yd	Width =	D+	24	in.			
Waste if Native Bed, Zone =		20.20	cu yd	Pit Depth =		4	ft.			
Surface Restoration Area =		851.85	sq yd	<= Wid+/Side		1	ft.			

Davis Bacon Wage Rate Kootenai County
Effective: 1/4/2013
Per DBA anyone working HAZMAT shall receive $1 above classification

TRADES			T&I	OH&P	
Carpenter	1	38.32	1.35	1	**$51.73**
Cement Mason	1	38.40	1.35	1	**$51.84**
Electrician	1	45.01	1.35	1	**$60.76**
Fence Laborer	1	35.08	1.35	1	**$47.36**
Flagger	1		1.35	1	**$0.00**
Ironworker	1	52.45	1.35	1	**$70.81**
Laborer	1	25.64	1.35	1	**$34.61**
Millwright	1	32.90	1.35	1	**$44.42**
Pipe Layer	1	35.58	1.35	1	**$48.03**
Oper-Heavy	1	39.71	1.35	1	**$53.61**
Oiler	1	37.90	1.35	1	**$51.17**
Painter	1	28.07	1.35	1	**$37.89**
Pile Driver	1	32.90	1.35	1	**$44.42**
Plumber	1	45.13	1.35	1	**$60.93**
Teamster	1	36.40	1.35	1	**$49.14**
Welder	1	52.45	1.35	1	**$70.81**

CREWS

Excavation

Foreman	1	40.71	40.71	Pickup	10.00	
Oper-Heavy	1	39.71	39.71	Trench Box	0.00	
Oiler	2	37.90	75.80	Loader	50.00	
Laborer	0	25.64	0.00	Excavator	100.00	
			156.22		160.00	
	T&I		1.35			
	OH&P		1		1	
			$210.90		**$160.00**	$ 370.90

Grub and Clear

Foreman	1	40.71	40.71	Pickup	10.00	
Oper-Heavy	1	39.71	39.71	Trench Box	0.00	
Oiler	0.5	37.90	18.95	Dozer	50.00	
Laborer	0	25.64	0.00		60.00	
			99.37			
	T&I		1.35			
	OH&P		1		1	
			$134.15		**$60.00**	$ 194.15

Hand Excavation/Backfill

Foreman	1	40.71	40.71	Pickup	10.00	
Oper-Heavy	1	39.71	39.71	Trench Box	0.00	
Oiler	0	37.90	0.00	Bobcat/Loader	25.00	
Laborer	3	25.64	76.92		35.00	
			157.34			
	T&I		1.35			
	OH&P		1		1	
			$212.41		**$35.00**	$ 247.41

Demolition Crew (Interior)

Foreman	1	40.71	40.71	Pickup	10	
Oper-Heavy	0.5	39.71	19.86	Small Equip	25	Manlifts, bobcats, etc
Oiler	0	37.90	0.00			
Laborer	3	25.64	76.92			
			137.49		35	
	T&I		1.35			
	OH&P		1		1	
			$185.60		**$35.00**	$ 220.60

Demolition Crew (Exterior)

Foreman	1	40.71	40.71	Pickup	10	
Oper-Heavy	1	39.71	39.71	60 ton crane	70	
Oiler	0.5	37.90	18.95			
Laborer	3	25.64	76.92			
			176.29		80	
	T&I		1.35			
	OH&P		1		1	
			$237.99		**$80.00**	$ 317.99

Well Installation

Foreman	1	39.32	39.32	Pickup	10	
Operator	1	38.32	38.32	60 ton crane	70	
Oiler	1	37.90	37.90	Forklift	0	
Pile Driver	2	32.90	65.80	Compactor	0	
			181.34		80	
	T&I		1.35		1	
	OH&P		1			
			$244.81		**$80.00**	$ 324.81

Pile Driver

Foreman	1	39.32	39.32	Pickup	10	
Operator	2	38.32	76.64	60 ton crane	70	
Oiler	1	37.90	37.90	Forklift	35	
Pile Driver	3	32.90	98.70	Compactor	0	
			252.56		115	
	T&I		1.35		1	
	OH&P		1			
			$340.96		**$115.00**	$ 455.96

Bed & Zone

Foreman	1	39.32	39.32	Hand Compactor (2)	3	
Operator	1	38.32	38.32	Loader	80	
Laborer	3	25.64	76.92	Pickup	10	
			154.56		93	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$208.66		**$93.00**	$ 301.66

Backfill

Foreman	1	39.32	39.32	Pickup	10	
Operator	2	38.32	76.64	Loader	80	
Laborer	1	25.64	25.64	Compactor	50	
			141.60		140	
	T&I		1.35		1	
	OH&P		1			
			$191.16		**$140.00**	$ 331.16

Steel Pipe

Foreman	1	40.71	40.71	Pickup	10	
Welder	2	52.45	104.90			
Oper-Heavy	1	39.71	39.71	Welder	25	
Oiler	1	37.90	37.90	Crane	120	
Laborer	3	25.64	76.92		155	
			300.14			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$405.19		**$155.00**	$ 560.19

Large DI Pipe

Foreman	1	40.71	40.71	Pickup	10	
Welder	0	52.45	0.00			
Oper-Heavy	1	39.71	39.71	Welder	0	
Oiler	1	37.90	37.90	Crane	100	
Laborer	4	25.64	102.56		110	
			220.88			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$298.19		**$110.00**	$ 408.19

PVC Pipe

Foreman	1	40.71	40.71	Pickup	10	
Welder	0	52.45	0.00			
Oper-Heavy	1	39.71	39.71	Welder	0	
Oiler	0	37.90	0.00	Excavator	80	
Laborer	3	25.64	76.92		90	
			157.34			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$212.41		**$90.00**	$ 302.41

Waste

Teamster	1	36.40	36.40	Truck & Trailer	35	
			36.40		35	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$49.14		**$35.00**	$ 84.14

Masonry

Foreman	1	39.32	39.32			
Carpenter/Laborer	3	38.32	114.96	Misc	10	
			154.28		10	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$208.28		**$10.00**	$ 218.28

Misc

Foreman	1	39.32	39.32			
Carpenter/Laborer	1	38.32	38.32	Misc	10	
			77.64		10	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$104.81		**$10.00**	$ 114.81

Sandblasting

Foreman	1	39.32	39.32	Air Compressor	15.00	
Oper-Heavy	1	39.71	39.71	Sandblasting Equip	5.00	
Carpenter/Laborer	2	38.32	76.64	Misc	10.00	
			155.67		30	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$210.15		**$30.00**	$ 240.15

Fencing Crew

Foreman/Operator	1	39.71	39.71	Crew Truck	10.00	
Fence Laborer	3	35.08	105.24	Tractor/Backhoe	25.00	
			144.95		35	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$195.68		**$35.00**	$ 230.68

Metals

Foreman	1	40.71	40.71	Pickup	10	
Ironworkers	2	52.45	104.90			
Oper-Heavy	1	39.71	39.71	Misc	10	
Oiler	0.5	37.90	18.95	Crane	100	
Laborer	2	25.64	51.28		120	
			255.55			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$344.99		$120.00	$ 464.99

Formwork

Foreman	1	39.32	39.32	1 Pickup	8	
Carpenter	1	38.32	38.32	1 Misc	10	
Laborer	1	25.64	25.64		18	
			103.28			
	T&I		1.35			
	OH&P		1	OH&P	1	
			$139.43		$18.00	$ 157.43

Rebar

Ironworker Foreman	1	53.45	53.45	1 Misc	10	
Ironworker	2	52.45	104.90	1 Forklift	25	
			158.35		35	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$213.77		$35.00	$ 248.77

Placement & Finishing

Foreman	1	39.32	39.32	1 Pickup	8	
Carpenter	1	38.32	38.32			
Cement Finisher	1	35.58	35.58	1 Power Trowel	5	
Laborer	1	25.64	25.64	1 Vibrator & Misc	10	
			138.86		23	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$187.46		$23.00	$ 210.46

Equipment

Foreman	1	40.71	40.71	Pickup	10	
Plumber/Elect	2	45.01	90.02			
Oper-Heavy	1	39.71	39.71	Misc	25	
Oiler	1	37.90	37.90	Crane	100	
Laborer	2	25.64	51.28		135	
			259.62			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$350.49		$135.00	$ 485.49

Electrical

Foreman	1	46.01	46.01			
Eletrician	1	45.01	45.01	Misc	5	
			91.02		5	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$122.88		$5.00	$127.88

Cleaning Crew

Laborer	2	25.64	51.28	Pickup	10.00	
Eletrician	1	45.01	45.01	Pump Rental	30.00	
				Untility Truck w/ Hois	30.00	
				Misc	5	
			96.29		75	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$129.99		$75.00	$204.99

Water Disposal System

Laborer	1	25.64	25.64	Poly Tank	25	
Teamster	2	36.40	72.80	Water Truck	60	
			98.44		85	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$132.89		$85.00	$ 217.89

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
Pig Launcher/Receiver Material Costs				
14" Butterfly Valve	2	EA	(b)(4) 1-95 [redacted]	
10" Butterfly Valve	1	EA		
14" x 10" Tee HDPE	1	EA		
16" x 10" Tee CS	1	EA		
16" x 10' Spool CS	1	EA		
16" Blind Flange CS	1	EA		
16"x14" Reducer CS	1	EA		
14" 45 Bend CS	1	EA		
14" x 4' spool CS	1	EA		
14" Wye HDPE	1	EA		
16" Bolt & Gasket	3	EA		
14" Bolt & Gasket	10	EA		
10" Bolt & Gasket	2	EA		
Misc Apertures (nozzles, cages, etc)	1	LS		
x2 for both launcher & receiver				

Costs don't include OH&P or installation

TRADES			T&I	OH&P			Davis Bacon Wage Rate Kootenai County
Carpenter	1	38.32	1.35	1	$51.73		Effective 1/4/2013
Cement Mason	1	38.40	1.35	1	$51.84		Per DBA anyone working HAZMAT shall receive $1 above classification
Electrician	1	45.01	1.35	1	$60.76		
Fence Laborer	1	35.08	1.35	1	$47.36		
Flagger	1		1.35	1	$0.00		Note: OH&P not included; included in the CPES estimate
Ironworker	1	52.45	1.35	1	$70.81		
Laborer	1	25.64	1.35	1	$34.61		
Millwright	1	32.90	1.35	1	$44.42		
Pipe Layer	1	35.58	1.35	1	$48.03		
Oper-Heavy	1	39.71	1.35	1	$53.61		
Oiler	1	37.90	1.35	1	$51.17		
Painter	1	28.07	1.35	1	$37.89		
Pile Driver	1	32.90	1.35	1	$44.42		
Plumber	1	45.13	1.35	1	$60.93		
Teamster	1	36.40	1.35	1	$49.14		
Welder	1	52.45	1.35	1	$70.81		
CREWS							
Excavation							
Foreman	0.5	40.71	20.36		Pickup	20.70	Per RS Means 4x4 3/4 ton
Oper-Heavy	1	39.71	39.71		Trench Box	0.00	
Oiler	0.5	37.90	18.95		Loader	65.75	Per RS Means 2.25 CY FE Loader
Laborer	0	25.64	0.00		Excavator	129.50	Per RS Means 1.5 CY Excavator
			79.02			215.95	
		T&I	1.35				
		OH&P	1			1	
			$106.67			$215.95	$ 322.62
Grub and Clear							
Foreman	0.5	40.71	20.36		Pickup	20.70	Per RS Means 4x4 3/4 ton
Oper-Heavy	1	39.71	39.71		Trench Box	0.00	
Oiler	0.5	37.90	18.95		Dozer	74.00	Per RS Means 105 HP Dozer
Laborer	0	25.64	0.00			94.70	
			79.02				
		T&I	1.35				
		OH&P	1			1	
			$106.67			$94.70	$ 201.37
Hand Excavation/Backfill							
Foreman	1	40.71	40.71		Pickup	20.70	Per RS Means 4x4 3/4 ton
Oper-Heavy	1	39.71	39.71		Trench Box	0.00	
Oiler	0	37.90	0.00		Bobcat/Loader	50.00	Per RS Means Backhoe/Loader, 80 HP
Laborer	3	25.64	76.92			70.70	
			157.34				
		T&I	1.35				
		OH&P	1			1	
			$212.41			$70.70	$ 283.11
Demolition Crew (Interior)							
Foreman	1	40.71	40.71		Pickup	20.70	Per RS Means 4x4 3/4 ton
Oper-Heavy	0.5	39.71	19.86		Small Equip	25.00	Manlifts, bobcats, etc
Oiler	0	37.90	0.00				
Laborer	3	25.64	76.92				
			137.49			46	
		T&I	1.35				
		OH&P	1			1	
			$185.60			$45.70	$ 231.30
Demolition Crew (Exterior)							
Foreman	1	40.71	40.71		Pickup	20.70	Per RS Means 4x4 3/4 ton
Oper-Heavy	1	39.71	39.71		Small Crane	107.70	Per RS Means 40 ton crane
Oiler	0.5	37.90	18.95				
Laborer	3	25.64	76.92				
			176.29			128	
		T&I	1.35				
		OH&P	1			1	
			$237.99			$128.40	$ 366.39
Well Installation							
Foreman	1	39.32	39.32		Pickup	20.70	Per RS Means 4x4 3/4 ton
Operator	1	38.32	38.32		Small Crane	107.70	Per RS Means 40 ton crane
Oiler	0.5	37.90	18.95				
Pile Driver	2	32.90	65.80				
			162.39			128	
		T&I	1.35			1	
		OH&P	1				
			$219.23			$128.40	$ 347.63
Pile Driver							
Foreman	1	39.32	39.32		Pickup	20.70	Per RS Means 4x4 3/4 ton
Operator	2	38.32	76.64		75 ton crane	182.13	Per RS Means 75 ton crane
Oiler	1	37.90	37.90		Forklift	22.60	Per RS Means 5000lbs
Pile Driver	3	32.90	98.70				
			252.56			225	
		T&I	1.35			1	
		OH&P	1				
			$340.96			$225.43	$ 566.39

Bed & Zone						
Foreman	1	39.32	39.32	Hand Compactor (2)	8.65	Per RS Means 18" Vibratory Plate
Operator	1	38.32	38.32	Loader	65.75	Per RS Means 2.25 CY FE Loader
Laborer	3	25.64	76.92	Pickup	20.70	Per RS Means 4x4 3/4 ton
			154.56		95	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$208.66		**$95.10**	$ 303.76
Backfill						
Foreman	1	39.32	39.32	Pickup	20.70	Per RS Means 4x4 3/4 ton
Operator	2	38.32	76.64	Loader	65.75	Per RS Means 2.25 CY FE Loader
Laborer	1	25.64	25.64	Compactor	28.90	Per RS Means 10 ton tandem roller
			141.60		115	
	T&I		1.35		1	
	OH&P		1			
			$191.16		**$115.35**	$ 306.51
Steel Pipe						
Foreman	1	40.71	40.71	Pickup	20.70	Per RS Means 4x4 3/4 ton
Welder	2	52.45	104.90	Trench Box	14.13	Per RS Means
Oper-Heavy	1	39.71	39.71	Welder	18.00	Per RS Means Welder Electric
Oiler	1	37.90	37.90	Crane	144.00	Per RS Means 40 ton crane
Laborer	3	25.64	76.92		197	
			300.14			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$405.19		**$196.83**	$ 602.01
Large DI Pipe						
Foreman	1	40.71	40.71	Pickup	20.70	Per RS Means 4x4 3/4 ton
Oper-Heavy	1	39.71	39.71	Trench Box	14.13	Per RS Means
Oiler	0.5	37.90	18.95	40 ton Crane	144.00	Per RS Means 40 ton crane
Laborer	4	25.64	102.56		179	
			201.93			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$272.61		**$178.83**	$ 451.43
PVC Pipe						
Foreman	1	40.71	40.71	Pickup	20.70	Per RS Means 4x4 3/4 ton
Oper-Heavy	1	39.71	39.71	Trench Box	14.13	Per RS Means
Oiler	0	37.90	0.00	Excavator	129.50	Per RS Means 1.5 CY Excavator
Laborer	3	25.64	76.92		164	
			157.34			
	T&I		1.35	OH&P	1	
	OH&P		1			
			$212.41		**$164.33**	$ 376.73
Truck Loading						
Operator	1	39.71	39.71	Loader	65.75	Per RS Means 2.25 CY FE Loader
			39.71		66	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$53.61		**$65.75**	$ 119.36
Waste Truck & Trailer						
Teamster	1	36.40	36.40	Truck & Trailer	94.13	RS Means Dump Truck 18 CY
			36.40		94	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$49.14		**$94.13**	$ 143.27
Waste Solo						
Teamster	1	36.40	36.40	Truck & Trailer	52.08	RS Means Dump Truck 18 CY
			36.40		52	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$49.14		**$52.08**	$ 101.22
Masonry						
Foreman	1	39.32	39.32			
Carpenter/Laborer	3	38.32	114.96	Misc	15.00	
			154.28		15	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$208.28		**$15.00**	$ 223.28
Misc						
Foreman	1	39.32	39.32			
Carpenter/Laborer	2	38.32	76.64	Bobcat/Loader	50.00	Per RS Means Backhoe/Loader, 80 HP
			115.96		50	
	T&I		1.35			
	OH&P		1	OH&P	1	
			$156.55		**$50.00**	$ 206.55
Sandblasting						
Foreman	1	39.32	39.32	Air Compressor	15.00	
Oper-Heavy	1	39.71	39.71	Sandblasting Equip	10.00	
Carpenter/Laborer	2	38.32	76.64	Misc	10.00	
			155.67		35	

		T&I	1.35			
		OH&P	1	OH&P	1	
			$210.15		$35.00	$ 245.15
Fencing Crew						
Foreman/Operator	1	39.71	39.71	Crew Truck	20.70	Per RS Means 4x4 3/4 ton
Fence Laborer	3	35.08	105.24	Tractor/Backhoe	50.00	Per RS Means Backhoe/Loader, 80 HP
			144.95		71	
		T&I	1.35			
		OH&P	1	OH&P	1	
			$195.68		$70.70	$ 266.38
Metals						
Foreman	1	40.71	40.71	Pickup	20.70	Per RS Means 4x4 3/4 ton
Ironworkers	2	52.45	104.90			
Oper-Heavy	1	39.71	39.71	Misc	10.00	
Oiler	0.5	37.90	18.95	20 ton Crane	107.70	Per RS Means 40 ton crane
Laborer	2	25.64	51.28		138	
			255.55			
		T&I	1.35	OH&P	1	
		OH&P	1			
			$344.99		$138.40	$ 483.39
Formwork						
Foreman	1	39.32	39.32	Pickup	20.70	Per RS Means 4x4 3/4 ton
Carpenter	1	38.32	38.32	Misc	10.00	
Laborer	1	25.64	25.64		30.7	
			103.28			
		T&I	1.35			
		OH&P	1	OH&P	1	
			$139.43		$30.70	$ 170.13
Rebar						
Ironworker Foreman	1	53.45	53.45	Misc	10.00	
Ironworker	2	52.45	104.90	Forklift	22.60	Per RS Means 5000lbs
			158.35		32.6	
		T&I	1.35			
		OH&P	1	OH&P	1	
			$213.77		$32.60	$ 246.37
Placement & Finishing						
Foreman	1	39.32	39.32	Pickup	20.70	Per RS Means 4x4 3/4 ton
Carpenter	1	38.32	38.32			
Cement Finisher	1	35.58	35.58	Power Trowel	6.63	Per RS Means 48" Walk Behind
Laborer	1	25.64	25.64	Vibrator & Misc	20.00	
			138.86		47.325	
		T&I	1.35			
		OH&P	1	OH&P	1	
			$187.46		$47.33	$ 234.79
Equipment						
Foreman	1	40.71	40.71	Pickup	20.70	Per RS Means 4x4 3/4 ton
Plumber/Elect	2	45.01	90.02			
Oper-Heavy	1	39.71	39.71	Misc	25.00	
Oiler	1	37.90	37.90	Crane	107.70	Per RS Means 40 ton crane
Laborer	2	25.64	51.28		153	
			259.62			
		T&I	1.35	OH&P	1	
		OH&P	1			
			$350.49		$153.40	$ 503.89
Electrical						
Foreman	1	46.01	46.01			
Eletrician	1	45.01	45.01	Misc	10.00	
			91.02		10	
		T&I	1.35			
		OH&P	1	OH&P	1	
			$122.88		$10.00	$132.88
Dredging of Pond						
Foreman	1	39.32	39.32	Pickup	20.70	Per RS Means 4x4 3/4 ton
Operator	1	38.32	38.32	75 ton crane	182.13	Per RS Means 75 ton crane
Oiler	1	37.90	37.90	Pump Rental	42.63	Per RS Means 5000lbs
Laborer	2	25.64	51.28	Hose 6" discharge	8	250 feet of 6" hose
			166.82		253	
		T&I	1.35		1	
		OH&P	1			
			$225.21		$253.01	$ 478.22

Waste Haul

Pond Sludge Waste Hauling Time		
0.4 miles one way @ 25 m/hr	0.032	hrs round trip
Loading, tipping, wait	0.2	per trip
	0.232	per trip
Trips per day	34	
Assume 4 cy per trip Solo	136	cy/day per truck
Dry Material Hauling Time		
0.4 miles one way @ 25 m/hr	0.032	hrs round trip
Loading, tipping, wait	0.2	per trip
	0.232	per trip
Trips per day	34	
Assume 18 cy per trip	612	cy/day per truck
Aerat Sludge Waste Hauling Time (50% load)		
0.4 miles one way @ 25 m/hr	0.032	hrs round trip
Loading, tipping, wait	0.2	per trip
	0.232	per trip
Trips per day	34	
Assume 10 cy per trip Truck & Trailer	306	cy/day per truck
Floc Sludge Waste Hauling Time (75% load)		
0.4 miles one way @ 25 m/hr	0.032	hrs round trip
Loading, tipping, wait	0.2	per trip
	0.232	per trip
Trips per day	34	
Assume 10 cy per trip Truck & Trailer	459	cy/day per truck
Berm Waste Hauling Time for fill		
0.2 miles one way @ 25 m/hr	0.016	hrs round trip
Loading, tipping, wait	0.2	per trip
	0.216	per trip
Trips per day	37	
Assume 18 cy per trip Truck & Trailer	666	cy/day per truck

BUNKER HILL CIA			**DATE:**	**7/8/2013**	
CTP DEFINITION			**PROJECT NO.:**	**382081.RD.03.35.05**	
CPES COST SUPPORT ITEMS			**ESTIMATE BY:**	**C. Moore**	
ORDER OF MAGNITUDE; CLASS 4			**REVIEW BY:**	**P. Bredehoeft/ATL, D. Cole/CLE**	
DESCRIPTION	**QTY**	**UNIT**	**TOTAL UNIT COST**	**TOTAL COST**	**COMMENTS**
			(b)(4) 1-95 [redacted]		
Demolition Items					
Demo Polishing Pond & Bldg	1	LS			
Dredge pond sludge via crane mounted pump, transfer to sludge pond via existing pipeline	8,889	CY			Based on pond surface of 24,000 sf with depth below grade of 10 ft. 5 days at 10 hours/day.
Connection to existing sludge pipeline	1	LS			Connect to pipe with 6" gate valve and misc piping.
Demo concrete liner	2,700	SY			Based on 2,700 sy, 6" thick slab, mesh or no reinforcing; RS Means 02411317
Demo conc walls	6,300	SF			Based on concrete 8" thick w/ reinforcing; RS Means 02411617; wall is 630 ft long x 10 ft high with 4 ft above grade
Fill pond with native material	8,889				
Place and backfill material	8,889	CY			Based on onsite material 10 ft deep
Material push by dozer included below	8,300	CY			No cost included below
Hauling Native material to pond, 18 CY Truck & Trailer	589	CY			3 miles @ 25 mile/hr + loading, dump, wait
Truck Loading at origin point	589	CY			
Demo Bldg Interior Items	5	DAY			1 wk, Misc small items, No salvage, protect Bldg
Salvage Pre-Fab Filter Bldg	3,200	SF			Bldg is 80ft x 40ft; RS Means 133419504700; use 50% high productivityas the time to erect new bldg
Transport Bldg to Storage Area	20	LOAD			Assume 20 loads on flatbed, 1 hour per trip to local site
Demo concrete perimeter footing	240	LF			Footing length 240 ft per engineer.
Demo concrete building slab	6,133	SY			Based on 6" thick rod reinforced slab; RS Means 02411317
Waste concrete	149	CY			
Hauling, 18 CY Truck & Trailer	149	CY			5 miles @ 25 mile/hr + loading, dump, wait
Truck Loading	149	CY			
Subtotal					
Idaho State Sales Tax	6%				
Demo Polishing Pond & Bldg					
Demo Aeration Basin	1	LS			
Salvage lime feed piping	180	LF			See comments below
Aeration basin sludge and sediments	873	CY			Based on 100 ft dia x 3 ft of sediments over area
Waste sludge and sediments	873	CY			
Hauling, 18 CY Truck & Trailer	873	CY			0.4 miles @ 25 mile/hr + loading, dump, wait; only fill 50% due to wet nature
Truck Loading	873	CY			
Spread waste at site	873	CY			
Flocc basin sludge and sediments	233	CY			Based on 900 sf x 7 ft of sediments over area
Waste sludge and sediments	233	CY			
Hauling, 18 CY Truck & Trailer	233	CY			0.4 miles @ 25 mile/hr + loading, dump, wait, only fill 75% due to wet nature
Truck Loading	233	CY			
Spread waste at site	233	CY			
Remove Basin PVC Liner	873	SY			No salvage
Remove Aeration Basin Mechanism	1	LS			Demo, remove, cut up
Remove Ripid Mixing Tank & Mech	1	LS			Demo, remove, cut up
Remove Sludge Pipes during berm demo	1	LS			Demo, remove, cut up
Remove Other Items	1	LS			Demo, remove, cut up
Slavage Lime Feed Pipeing & Valves	1	LS			Protect and salvage
Demo Aeration Berm	8,300	CY			Use for pond fill, 8,300 cy per engineer.
Dozer Push to Pond	8,300	CY			Additional dozer to push material to pond.
Demo Flocc Walls	900	SF			Based on concrete 8" thick w/ reinforcing; RS Means 02411617; walls 30ft by 30 ft x 10 ft high.
Demo Flocc Slab	900	SF			Based on 6" thick rod reinforced slab; RS Means 02411617
Subtotal					
Idaho State Sales Tax	6%				
Demo Demo Aeration Basin					
Total Demolition					
ACCURACY RANGE (Rounded)	**40.0%**				**Included on CPES**
	-20.0%				**Included on CPES**

BUNKER HILL CIA			**DATE:**	**7/8/2013**	
CTP DEFINITION			**PROJECT NO.:**	**382081.RD.03.35.05**	
CPES COST SUPPORT ITEMS			**ESTIMATE BY:**	**C. Moore**	
ORDER OF MAGNITUDE; CLASS 4			**REVIEW BY:**	**P. Bredehoeft/ATL, D. Cole/CLE**	
DESCRIPTION	**QTY**	**UNIT**	**TOTAL UNIT COST**	**TOTAL COST**	**COMMENTS**
Assumptions:					
1 Polishing pond is an concrete lined pond and will be emptied prior to pond demo.					
2 Pond sludge removal is based on 10ft of sediment left over top of pond liner.					
3 The polishing pond material will be dredged via crane mounted pump and piped in exsting pipeline to sludge pond.					
4 Waste material can be disposed of at nearby Bunker Hill waste repository.					
5 Fill pond with either native material from Bunker Site. Pond bottom is 10' feet below grade.					
6 Building salvage time for reuse is same as time to erect new. Bldg components are transported to local site for storage.					
7 Lime feed piping is above grade on pipe supports with 6 pipe arrangement. Pipe and valves will be salvaged.					
8 Aeration basin is earthen containment with liner and will be emptied and dried prior to demo.					
9 Aeration Basin sludge removal is based on 3 feet of sediment left over top of liner.					
10 Aeration Basin berm will be used for polishing pond fill.					
11 Flocc Basin sludge removal is based on 6 feet of sludge/sediment.					
12 Flocc Basin slab is assumed to be 6" depth, walls 8" thk and 10' high.					
13 Flocc Basin north wall to remain as it is common wall to pump room.					

NOTE: The above cost opinion is in May 2013 dollars and does not include future escalation, right of way, construction management, legal, administrative, financial or O&M costs. The cost opinion shown has been prepared for guidance in project evaluation from the information available at the time of preparation. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Appendix A
Decision Log

Bunker Hill, Phase 1 CTP Upgrades and Groundwater Collection System Remedial Design
PROJECT DECISIONS TRACKING LOG

CH2M HLL PROJECT No.: 382081

PRINTED DATE: **8/29/2013**

DECISION TRACKING							
PROJECT ISSUE					ISSUES & ACTIONS TRACKING	REFERENCE DOCUMENTATION	
Item No.	**Work Element (GWC, CTP, Tech Disc or Facility)**	**Description**	**Date Recorded**	**Date Closed**		**Meeting Notes, E-Mails**	**Other**
1	GWC	**ROW, easements for cutoff wall and pipelines**	6/26/13		**6/26/13**: teleconference with ITD. FHWA, EPA, USACE, and CH2M HILL to discuss cut-off wall construction approach, location wrt property boundaries and highway loading prism. **Outcome and Action Items:** Dianne Jordan/USACE prepared meeting meetings from the call and distributed to the group. CH2M HILL will continue subcontract procurement for the surveyor. CH2M HILL will keep EPA and USACE apprised of survey progress.		
					7/23/13: CH2M HILL subcontracted with CdA surveyor for boundary control and utility locate surveys. On-site beginning week of 7/15 and will complete week of 7/29. CH2M surveyors conducting additional laser topo survey from 7/24 - 7/31. Data reduction asap to support property access and easement work led by USACE.		
					8/21/13: Field portion of both CH2M HILL and Ruen-Yeager survey work is complete. CH2M HILL has compelted post-processing of survey data and incorporated into base maps. R-Y is estimating their portion of work complete by end of September.		
2	GWC, CTP	**Alignment of effluent pl and force main header**	6/26/13		**7/23/13:** Inter-related to Item No. 1. need to complete topo survey to evaluate pipeline routing; as agreed in July 2 DDR workshop, geotech exploration program also needed for revised pipeline alignment. Geotech scope provided to EPA on 7/23 (also inlcudes explorations in SPA area).		
3	Effluent Discharge - Flooding Impact	**FEMA "No-Rise" criteria**	6/26/13		June 4 e-mail from Joan Stoupa to EPA (Ed, Kim) summarizing FEMA flood requirements and expected CTP effluent flows. **Action Item:** Ed to discuss with Anne McCauley/EPA who has been involved in tracking the FEMA issues in the Basin including the "Silver Jacket" group. Joan to find out extent of work to apply for a "No-Rise" certificate. Need to determine if FEMA would require detailed hydraulic analysis or consider the added effluent as insignificant.		
					7/23/13:Update from Ed and Anne McCauley: **Joan's Update:** Should be farily straight-forward on techncial analysis and development of a TM. Still need to get feedback whether tech analysis needed. Generally you start with floodplain administer --- City of Kellogg.		
					8/21/13: No activity (to CH2M HILL's knowledge) since last progress meeting		
4	GWC	**USACE concerned about influence of cutoff wall on flooding**	6/26/13	8/21/13	June 4 e-mail from Joan Stoupa to EPA summarizing CH2M HILL's opinion that cutoff wall will have no adverse effect on flooding. **Action Item:** **Document in Schematic Design BDR**		30% BDR

DECISION TRACKING							
PROJECT ISSUE					ISSUES & ACTIONS TRACKING	REFERENCE DOCUMENTATION	
Item No.	Work Element (GWC, CTP, Tech Disc or Facility)	Description	Date Recorded	Date Closed		Meeting Notes, E-Mails	Other
5	CTP Effluent Limits	**What are effluent limits, compliance requirements, mixing zone, etc**	6/26/13		Initial discussions with EPA on June 14 teleconference of potential advantges of SFCDR mixing zone to meet some difficult treatment parameters. **Action Items:** EPA and CH2M HILL agreed that this is a key issue that needs focused discussions and strategy after July 4 holiday. Joan to discuss within CH2M HILL what the LOE and time-line could be to apply for a mixing zone.		
					7/23/13: Joan's Update: LOE to apply for mixing zone depends on amount of existing data. Likely that intermediate to comprehensive study may be needed with field work. Could be in the range of$100k to $300k depending on data, modeling needs, and reporting requirements. Still feels like a first step is figuring out if IDEQ would even entertain a mixing zone on the SFCDR.		
					8/21/13: CH2M HILL prepared summary info on reasons why filters are needed to comply withpotential future limits and spreadsheet of potential regulatory avenues for mitigation/variances/waivers on difficult to treat constituents and discussed with EPA and USACE in a teleconference on 8/12/13. EPA has designated Jen Edwards/EPAHQ to lead their efforts on working with EPA NPDES permit writers. CH2M reviewed Lucky Friday and US Silver NPDES permits and provided summary e-mail to EPA on potential implications to a permit for CTP effluent.		
6	CTP	**Selenium issue**	6/26/13		Note: This is a critical issue in determining CTP effluent water quality criteria and mixing zone application. Action: CH2MHill will compile data and current status of knowledge on SE and its presence in mine water and/or OU2 and OU3 ground water and provide to EPA so that the next steps can be determined in assessing a plan to address selenium. After information is submitted to and discussed with EPA it will be determined if additional data needs to be gathered to provide sufficient information and determine if Selenium is high within the mine water or other waters to be treated at the CTP. Action Item: CH2M HILL to come prepared to discuss further at July 2nd workshop and prepare a current status memo for discussion.		
					7/23/13: Outcome from 7/16/13 teleconference with EPA was that Se testing program of analytical methods should be conducted. CH2M Hill provided EPA QA officer with 1998-1999 lab data CASE #s so that EPA could begin their evaluation of prior data quality. CH2M HILl estimated # of samples for testing and locations and submitted to EPA. Next step is to agree on scope/schedule and begin QAPP addendum.		
					8/21/13: E-mail from EPA QA officer that their review of 1998-1999 data set showed no quality issues. CH2M HILL prepared a QAPP addenda for sampling KT and 9PU (mine pool) locations 2 times and having analysis at both ASL and Manchester (with CLP for anions). **Draft QAPP addendum submitted for EPA review on 8/12/13; final QAPP addendum submitted to EPA on 8/29/13; sampling planned for 9/3 and 9/4/2013.**		
7	CTP	**Treatment during Construction**	6/26/13		6/26/13: Discussed prescriptive versus performance approaches for the on-going O&M for influent during construction. General consensus was performance approach and let the Contractor have this responsibility. Action Item: To be discussed again at July 2 workshop when Corps can participate.		
					7/23/13: Not sure this was discussed at July 2 workshop.? Feedback from others?		
				8/21/13	**8/21/13:** Based on adjudicated comments/responses to draft PDDR, performance based approach will be assumed and approach will be advanced during Schematic Design and reported in the 30% SD Basis of Design Report.		30% BDR
8	GWC	**Disposal of Slurry Wall Spoils**	8/21/13		**8/21/13:** As described in Section 4.9 of GWCS PDDR, between 32k cubic yards and 37 k cyd of waste soil will likely need disposal from construction of slurry wall. Need to actively evalute most cost effecitve options, including Page Repository.		